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THE KELVIN EXERCISES.

It was altogether felicitous and appropriate that the American Institute of Electrical Engineers should hold memorial services in honor of the late Lord Kelvin. This distinguished physicist was not only one who had done much to bring this country in closer social and commercial intercourse with his own by means of the submarine cable, but his relationships with our leading electrical engineers were always and throughout of the most friendly and intimate character. The remarks and reminiscences at the exercises were in themselves a clear evidence of this, if any were needed. But Lord Kelvin had also from the first taken a deep interest in the welfare of the Institute, had extended hearty courtesies to it and had accepted grateful courtesies in return. The officers of the Institute are to be congratulated upon this function, and upon the dignity and success that attended this effort to pay a final tribute to one who was never more happy than when on these shores studying American advance and, in his own words, deriving fresh inspiration from contact with American electrical engineers.

From 1884, when the Institute was founded, and when the first annual meeting was held at Philadelphia, down to 1902, when Lord Kelvin last visited this continent, was a period of tremendous electrical development, and the 20 years embraced advances and inventions on this side of the water that appealed strongly to the intensely practical side of his nature. Aged as he was at the time of his departure, he expressed quite cheerfully the hope of coming over again in a few years to find new objects of interest and admiration. His life and work remain a stimulus, which will be all the greater if we realize that as in his case, it is possible to prosecute and promote the furthermost researches of pure science without loss of scientific dignity, while urging on to their best endeavor the men who are striving to turn discovery to the benefit of mankind. This he never disdained, but, on the contrary, he was ever ready to construct and design, the compeer in his time of any other great inventor.

THE SLIDE RULE IN THE CALCULATION OF REACTANCE

As Thomas Carlyle remarked, man is a tool-using animal. In fact, we might refine upon this remark, and say that the engineering man is a slide-rule using animal, a creature that is apt to have a slide rule in his inside jacket pocket. It is really wonderful that a rule carrying a divided scale ten inches long should be able to effect a single multiplication or division to a precision of at least 1 part in 500. During the last few years, the slide rule has become the engineer's *vade mecum* in all parts of the civilized world. The designing and computing offices of engineering works have been described by casual visitors as places where the men spend their time in pushing slide rules. A number of methods of computation adapted to the slide rule have appeared in our columns since 1900. Thus, we have

methods for computing the diameter or area of any given size of wire, the change in resistance of copper conductors with temperature, and of the size of wire required for a given distance, current and drop. The object of these methods is not merely to facilitate computation, but also to dispense with tables, making the slide rule take the place of a table.

On page 142 we publish this week another slide-rule method of computation, by Mr. M. S. Howard, for calculating the reactance of alternating-current transmission lines. A formula is first derived which expresses the reactance per thousand feet of wire at the frequency of 60 cycles per second in terms of the logarithm of a square root, and this is readily applied to the slide rule. There can be no doubt that where many such reactances have to be worked out successively, or where such reactances have frequently to be computed, this formula will save time to learn and to use. When, however, such computations only occur at rare intervals in the particular work of an engineer, it is questionable whether it is worth while spending much time in learning this slide-rule method, because it becomes doubtful whether he will remember the method so as to apply it with confidence when the time comes. He had better be able to reconstruct in his mind the fundamental formula for reactance in case he has no tables available, even though the practical computation should thus be rendered longer and more cumbersome. Or, he might record the formula on the back of his slide rule. This does not, of course, depreciate the value of the slide-rule method for those who are in a position to employ it frequently.

It might be worth the pains of some manufacturer of slide rules to print indelibly on the backs of the rules some of these slide-rule formulas. An electrical engineer's slide rule would then differ from a civil engineer's slide rule, in respect to the data furnished on the back of the rule. It is remarkable how much data can be recorded in compact form in the 25 sq. cms. available surface on the back of a slide rule. It has been aptly said that Napier's invention of the logarithm tables has virtually doubled the lives of astronomers since his day. Engineers do not, of course, ordinarily occupy themselves with computing or logarithms as much as the average astronomer, but the slide rule has undoubtedly enhanced the benefit of logarithms to the engineer by engraving them on tablets of wood and celluloid for his ready transportation. The adaptation of frequently recurring formulas to slide rule use is distinctively a twentieth century accomplishment.

Series-Repulsion Railway Motor.

As noted on page 144 of this issue, Mr. E. F. Alexanderson at the January meeting of the A. I. E. E. described a type of single-phase commutator developed for railway service within the past few months. As actually built, the motor is provided with a fractional-pitch armature winding such as is commonly used on a direct-current motor, its main field coils are arranged in a manner identical with that used with a compensated single-phase series motor, while its "compensating" coils differ from those of the latter machine in being given twice as many turns as the armature, and in being subjected to an e. m. f. in time-phase with the supply e. m. f. rather than being required to carry a current in direct phase-opposition with the armature current. Under running conditions, the machine possesses the advantage over the compensated-series motor of exhibiting no tendency to spark at the brushes, and the relative disadvantage of operating at a lower power factor. At starting the machine has an advantage over the corresponding compensated-series motor in possessing a decreased short-circuit voltage at the coil under the brush for the same starting torque, but is at a disadvantage in comparison with a motor having resistance-leads in that even the lower voltage produces a greatly increased short-circuit current.

It would seem that the disadvantageous lower power factor under running conditions can be rendered of secondary importance, because the problem of increasing the power factor of a single-phase commutator motor is one that permits of a simple and easy solution. It can safely be stated, therefore, that the Alexanderson motor at running speed possesses advantages that greatly overbalance its disadvantages. The disadvantageous starting conditions inherent in all simple forms of single-phase commutator motors have not been eliminated in the new machine, although an attempt has been made to minimize the cause for the heating and sparking at very low speeds, or with stationary armature. To what extent the excellent running characteristics of the Alexanderson motor overbalance its poorer starting features, only actual operation under service conditions can determine. Doubtless, however, when the design proportions are such, and the equipment can be so arranged, that the armature cannot be stalled and is never required to run at low speed for any appreciable length of time, the new motor will give good service. Thus the machine seems well adapted for single-car interurban service and for multiple-unit train propulsion. The starting conditions in locomotive service are much more severe, and experience will be necessary before final judgment can be passed as to the adaptability of the new motor for use with locomotive work.

Solenoids in Series with Resistance.

The solenoid is the favorite form of electromagnet intended for a long pull and a strong pull. It is not, of course, the only type of electromagnet capable of assuming such duties, but it is a form which has done good service in this respect, and with which much experience has been already gathered. The behavior of a solenoid of arbitrarily assigned dimensions and winding, is a very complex matter to analyze and determine. Nevertheless, in certain standard forms of jacketed solenoid, the laws of the pull at different points of the stroke have been fairly well cleared up, so that an experienced designer can frequently predict the pull of a standard solenoid with a satisfactory degree of precision. The ordinary data are the voltage applied to the solenoid, the initial pull required and the limiting current strength or the watts developed in the coil. In recent years, solenoids are frequently installed with a resistance in series inserted either automatically at the end of the stroke, or permanently, thereby reducing the current and power in the solenoid. Special modifications of the ordinary formulas have to be adopted in the design and computation of such solenoids. The matter is discussed by Mr. Charles R. Underhill in the article on page 140.

The article shows clearly that if we have to work a solenoid through a given extra resistance, say 200 ohms, on a constant-potential circuit of, say, 500 volts, we shall develop maximum

watts in the solenoid when we make its resistance equal to the fixed external resistance, or 200 ohms in the case considered. Because, if we make the solenoid's resistance very small we may get a current of nearly 2½ amperes, but with only a very small voltage across the solenoid terminals. On the other hand, if we make the resistance of the solenoid very large, we may get nearly 500 volts across its terminals, but the current will be very feeble. With a 200-ohm solenoid the current would be 1¼ amperes, and the voltage 250, or half of that between mains, making the power a maximum at 312.5 watts in the solenoid, which will be half the power delivered by the mains. Nevertheless, the maximum is not very sharp, and a distinct deviation from equality between internal and external resistance can be made without departing markedly from the maximum watts. Thus, the solenoid might have 250 ohms, and the watts would only diminish to 308.5, a fall of roughly one per cent, or the solenoid might have 150 ohms, and the watts would only diminish to 306, a fall of roughly two per cent.

Having a given size and volume of winding space on the solenoid, the designer usually seeks for a winding which will give the maximum ampere-turns for a given external resistance in series. If this should give unnecessarily great magnetic power, then the design can be improved in economy either by reducing the size of the solenoid, or by increasing the external resistance in series, or both. It is shown that if the thickness of insulating covering on the wire were negligibly small, the winding most powerful in ampere-turns would also be the winding most powerful in watts; that is, with equal internal and external resistance. But owing to the complication produced by the insulating covering, the resistance usually has to be made less than that for maximum watts, and in a general way it is recommended that the next larger size of wire be adopted than works out, with the insulation, for maximum watts. This is a useful rule. The formulas employed would be much simpler if the inch were not employed for workshop purposes, as the unit of length. In practice this will not make much extra difficulty, but in simplifying the steps of the reasoning the metric system offers great advantages.

DANGERS OF ARTIFICIAL LIGHTING.

Dr. Seabrook's paper, read before the Illuminating Engineering Society, and abstracted elsewhere in this issue, is of importance as pointing out some of the dangers incurred in using powerful illuminants. In particular, he lays great stress on the danger of too powerful ultra-violet rays, which have certainly been shown to produce serious lesions of the cornea, iris, and lens. It appears to us, however, that in his paper there is some confusion between this particular action and the general effect of too strong light upon the retina itself. If the action of light upon the retina is due to photochemical action, as is generally believed to be the case by physiologists, then danger from overstimulation of the retinal layer should depend on its photochemical sensitiveness. This, as is well known, has its maximum, not in the red or violet of the spectrum, but at the point where a given amount of luminous energy has the maximum effect, *i. e.*, in the yellow or yellowish green. The rays which may be called actinic with respect to photographic action are relatively very ineffective in vision, and consequently can hardly be supposed to produce considerable photochemical changes in the retina itself. The serious results of too bright light on the retina cannot, therefore, be properly charged against the rays which are known to be ineffective in stimulating it.

On the other hand, there can be little doubt that ultra-violet light if sufficiently concentrated, may get through to the retina in damaging amounts. But this action, if present, must be exercised in the main on other things than the photochemical elements there present, which are incapable of reacting strongly to ultra-violet rays. Hence any possible damage of this sort is incidental rather than direct. In fact, ultra-violet light, unless strongly concentrated, seems to be entirely harmless. Diffused sky light, which is far richer in violet and ultra-violet rays than any common artificial illuminant, is certainly most inoffensive, although its so-called actinic power, as shown for instance, on the ordinary photographic plate, is very high. So far as so-called actinic rays go there is very little difference between incandescent lamps and flames, including the kerosene flame. Arc lamps, especially the enclosed arc of small amperage, give more violet and ultra-violet rays, but even these give a far smaller proportion of such rays than does sky light. The only artificial lights which are conspicuously rich in ultra-violet radiation are the quartz mercury arc and the iron arc used by Finsen. That these at short range are dangerous there is no manner of doubt, and it is worth enquiring whether the titanium arc now in experimental use may not be equally so. Yet even in these cases it is very doubtful whether anything short of extreme concentration of the radiation would produce serious results, and it is reasonably certain that any system of shading which would bring the luminous intensity within reasonable bounds would also effectively cut off the ultra-violet.

Aside from these extreme cases the deleterious effects of too intense light must be charged up to excessive intrinsic brilliancy rather than to special peculiarities of radiation. As Dr. Seabrook very happily pointed out, too intense stimulation may overburden even to permanently crippling the recuperative powers of the retina. Such overstimulation depends on the concentration of energy in the image, which, at short range, depends in turn on the intrinsic brilliancy, *i. e.*, the luminous radiation per unit of surface, of the source. Hence one has an entirely sufficient reason for the infrequency of overstimulation from oil lamps and the like, which have an intrinsic brilliancy of only a few candle power per square inch, as against some hundred in the case of arcs and high-efficient incandescents. The obvious moral is to shade all such sources so as to keep the intrinsic brilliancy low. In the case of natural lighting by diffused daylight the intrinsic brilliancy is considerably lower than in artificial lighting with unshaded sources, and is correspondingly less likely to cause trouble. From the same instructive standpoint of recuperation, the explanation of the good effects of amber glass in protecting the eye become obvious, for amber glass, with its selective transmission in the yellow, lets through precisely those rays which enable one to see most with the minimum access of total energy to the retina. It therefore will have a minimum total work of recuperation to do to compensate for the necessary stimulation. The retina works most efficiently by yellow light, but it must not be overworked even with this, and we are inclined to think that the flaming arc at short range would produce very serious results despite its relative weakness in the violet. Suitable shading is the remedy for all such difficulties.

The Chicago Electrical Show.

As we go to press word comes of the successful opening on Monday evening of the third annual electrical show in Chicago. These Chicago shows have come to have an established place as a kind of midwinter meeting place for the electrical men of the Middle West. They serve not only as an exposition of new appliances for the benefit of electrical men from a large surrounding territory, but give the local central-station and supply interests a chance to read the general public of a great city. Incidentally, in showing to the public of Chicago the various applications of electricity, it also brings before the visiting central-station man some of the latest popular uses for central-station service, which he may go home and introduce in his own town. The decorative lighting scheme of the Chicago show this year is exceptionally elaborate, as described in our issue of last week. It is undoubtedly the best thing of the kind yet done at a temporary show of this nature.

The Chicago show of last year went into history as the first public exhibition of American-made tungsten incandescent lamps in this country. This year's show marks an equally important advance, namely, the exhibition for the first time of quantities of American-made tungsten lamps, not as curiosities, as heretofore, but as regularly manufactured articles available in considerable quantities for common commercial use. Some amusing stories (now amusing, but at that time harrowing), are told of the difficulties of transplanting some of those early tungsten lamps to last year's Chicago show. Difficulties of breakage in transportation seem to be rapidly diminishing, with improvements in manufacture and packing. Next week we shall present in convenient shape for easy reference and reading an account of the new things, both large and small, at the show. The list of new appliances exhibited for the first time at this show is a long one.

Kelvin Memorial Exercises.

Memorial exercises in honor of Lord Kelvin were held in the Engineering Societies' Building, New York, in the main auditorium, on Sunday, Jan. 12, at 3:30 p. m., when in spite of severe weather the attendance was large. The affair was under the direct auspices of the American Institute of Electrical Engineers, of which Lord Kelvin had long been an honorary member, but a number of other societies assisted, their names and official representatives being as follows: American Association for the Advancement of Science, Prof. Edward L. Nichols, retiring president; American Electrochemical Society, Dr. E. F. Roeber, chairman executive committee; Prof. Joseph W. Richards, secretary; American Institute of Mining Engineers, Dr. A. R. Ledoux, past president; American Philosophical Society, Mr. Andrew Carnegie, Prof. Michael I. Pupin; American Mathematical Society, Prof. J. Howard Van Amringe, LL.D.; American Society of Civil Engineers, Mr. Charles Macdonald; American Society of Mechanical Engineers, Rear Admiral George W. Melville, U. S. N., past president and honorary member; American Street and Interurban Railway Association, Prof. B. V. Swenson, secretary; Association of Edison Illuminating Companies, Mr. John W. Lieb, Jr., past president; Franklin Institute, Mr. T. Commerford Martin, corresponding member; Institution of Electrical Engineers (Great Britain), Mr. George G. Ward, honorary secretary and treasurer for U. S. A.; Illuminating Engineering Society, Dr. C. H. Sharp, Dr. A. H. Elliott; National Electric Light Association, Mr. Dudley Farrand, president; Mr. W. W. Freeman, secretary; New York Electrical Society, Prof. A. F. Ganz, president; Mr. G. H. Guy, secretary.

The exercises were accompanied by music furnished by the Kronold Sextette, Mr. Hans Kronold giving "Oh, Rest in the Lord" as a 'cello solo. The prayer and benediction were pronounced by the Rev. W. T. Manning, D.D., who also delivered an excellent brief address on Lord Kelvin's strong Christianity and his reverent nature.

President H. G. Stott, of the Institute, spoke in his introductory remarks from acquaintance with Lord Kelvin, and as to his modesty in spite of all his achievement quoted his utterance: "I have lived long and I have learned enough to realize I know nothing."

Prof. Elihu Thomson spoke of Lord Kelvin as an electrical engineer. He declared that his life was a standing rebuke to those who affect to find a superior merit in working for pure science over working for practical results. Nothing could be less sordid, he declared, than Kelvin's desire to achieve practical results. "It is characteristic of Lord Kelvin," he went on, "to note that his conceptions were complete from the beginning. A pioneer is hampered by lack of men, material, and experience, but on Kelvin's inventions later work only helped out the details, and these were often provided for from the start."

In reviewing the great scientist's visits to America, Professor Thomson spoke of his views with regard to Niagara. "To him there was just as much romance and sublimity in founding great communities, in making real additions to the wealth of the world, in extinguishing the smoke of railroads and lighting towns hundreds of miles away as in a mass of water falling over a precipice. In this I concur. In the daytime there may be many elements of sublimity in the fall, but remember they go on unseen at night or when they are obscured by fog and mist." Professor Thomson in his address referred specifically to many inventions made by Lord Kelvin in electro dynamics and mentioned his dynamo and his instruments of precision.

To Prof. E. L. Nichols, of Cornell, was assigned the topic of "Kelvin as a Scientist." He compared him in his preeminence to Helmholtz, and pointed out how hard it is to realize the state of science in 1841, when Kelvin went up to Cambridge, and there were few railroads or steamships, and the telegraph and telephone were entirely unknown. "To Kelvin," he said, "science meant first an effort to give the precise mathematical relation between things and to guess at hidden relations; second, to grasp the mechanism of things when it could be seen or to imagine it when it could not. He had a passion for computation, and in an address at Philadelphia he protested against what he termed the barbarous system of English measurements. He declared it held science in bondage, and hoped that America would free itself from it." This summary by Professor Nichols of Kelvin's physical work was full and admirable.

Mr. George G. Ward, vice-president of the Commercial Cable Company, paid an eloquent and comprehensive tribute to Kelvin's work as a submarine cable engineer and inventor, and spoke as one who had worked from the earliest period of their introduction with his mirror galvanometer and his siphon recorder. Mr. Ward presented a striking list or summary of the work done in this difficult field by one who was so distinctively a pioneer in it.

Rear Admiral G. W. Melville, U. S. N., followed with an equally graphic sketch of the work done by Kelvin in the field of marine engineering, with reference particularly to his compass and his deep sea sounding apparatus. He spoke also from intimate personal knowledge and acquaintance.

Mr. T. C. Martin, past president of the Institute, said that Lord Kelvin, attending the Electrical Congress and Exhibition at Philadelphia, did much to help the struggling Institute, then just brought into existence, by advice and sympathy. Thrice president of the kindred institution in England, his suggestions and ideas had been most helpful and valuable at a time when all the encouragement was needed that could be got. It was natural that Lord Kelvin should early become an honorary member and that the relationship thus early established should be maintained down to the time of his death. The Institute was officially represented at the jubilee of his professorship at Glasgow University in 1896, and when he returned to this country for the last time in 1902 a reception was given him by the Institute, with other societies, at Columbia University, attended by over 2000 persons.

For the exercises a special 6-page programme of simple and dignified design was printed, giving Lord Kelvin's European

and American memberships and decorations, and accompanied by the sonnet of Prof. W. M. Stine, printed in these pages last week.

Automobile Engineers.

The Society of Automobile Engineers held its third annual meeting in New York, Jan. 3, with President A. L. Riker in the chair. Several papers were read and discussed.

The annual dinner was held in the evening, followed by a second business session. It was decided to hold quarterly meetings hereafter, the next one being scheduled for Boston during the progress of the local automobile show there, March 7 to March 14. The following-named gentlemen were elected officers for the ensuing year: Thomas J. Fay, of New York, president; E. T. Birdsall, of Rochester, N. Y., second vice-president, and Henry Hess, of Philadelphia, treasurer; Russell Huff, of Detroit, and F. J. Newman, of Chicago, managers for three years. President Fay appointed Charles B. Hayward as secretary.

January Meeting of the New York Section of the I. E. S.

At the meeting of the New York section of the Illuminating Engineering Society, held on Jan. 9, the following section officers were elected for the year 1908: Chairman, Mr. W. W. Freeman; managers, Messrs. W. C. Morris and Albert Mahle; secretary, Mr. P. S. Millar.

The paper of the evening was read by Dr. H. H. Seabrook, on the "Effects of Light Upon the Eye." After explaining the optic nerves, pigment layer, retina, lenses and cornea of the eye, Dr. Seabrook stated that of the various rays of the luminous spectrum those towards the violet end are the most harmful to the eye. Disintegration and disassociation of the cells in the pigment layer, occurring from exposure to light, are at a minimum in the yellow.

The most satisfactory light is, no doubt, daylight (not sunlight) a few feet within a closed window on a bright day. In this light, finer lights and shadows and delicate colors may best be distinguished by healthy eyes. A greater distance from the source of light diminishes vision, and even taking away the protection of the window glass, causes more dazzling and decreased retinal endurance. The adaptability of the eye is small for increased illumination, and the limits of increase of vision with stronger light is within the medium limits of illumination. The movable kerosene lamp may be, and is usually, placed in a good position to illuminate the object, while the incandescent electric lamp is usually not well placed, often in offices being rigidly fixed so that either the eyes must be subject to direct light, or the head must be bent forward for work, congesting the eyes. No amount of green on a tin shade will correct this improper permanent position of the lamps.

Present lighting effects may be improved by attention to position, including the distance of the source of light from the eyes, as measured by the course of the rays, and protection of eyes by glass properly colored. Light weak in chemical rays is better suited to the eyes than any other.

Many substances absorb chemical rays and allow luminous rays to pass. For practical purposes there seems no need to consider any of them except glass as a protection for the eyes from the intrinsic brightness of too intense light. Neither does there seem any question that yellow is the color to choose to conserve or improve vision and protect the eyes from the chemical action of light. Globes may be used of pink, orange, red, or green, as desired, when the light may be diminished in luminous qualities. It is best to choose for protective purposes that shade of yellow which appears in the best ray filters or is shown in the glass used for modifying the light of developing rooms for photographic plates. This amber yellow may be darkened by a brown admixture for weak or diseased eyes, or to protect from unusual light exposure.

Growth of Western Society of Engineers.

The Western Society of Engineers held its thirty-eighth meeting and banquet at the Chicago Atheletic Association, Jan. 7, 1908. Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company of Chicago, the retiring president, acted as toastmaster. He announced that the society had just reached a membership of 1000. Civil engineers outnumbered the mechanical and electrical in the society, but the majority of papers had been on mechanical and electrical engineering topics. The very important announcement for Chicago engineering circles was made that the society directors had just entered into a 10-year lease for space in the Monadnock Block, which will enlarge the present quarters 100 per cent and afford a larger meeting room with high ceilings in place of the inadequate quarters in which the society has been suffering recently. In the present quarters good ventilation has been impossible, and this has affected both the attendance and the value of the discussions. As both the Western Society of Engineers and the Chicago section of the American Institute of Electrical Engineers hold meetings in these quarters, this matter is of interest to a large number of electrical men in Chicago. At the annual election of the society, electrical interests were represented by the election to the second vice-presidency of Mr. Peter Junkersfeld, electrical engineer of the Commonwealth Edison Company.

Investigation of Centrifugal Pumps.

The recent construction of a complete hydraulic laboratory at the University of Wisconsin has given opportunity for investigation along various lines of hydraulic engineering. The first bulletin, entitled "Investigation of Centrifugal Pumps. Part I. A Discussion of the Theory of the Centrifugal Pump and Tests of a Six-Inch Vertical Centrifugal Pump," has just been issued by the university.

Referring to the theory of the centrifugal pump, the bulletin discusses the general theory as ordinarily given for deriving the theoretical head developed by the impeller of a centrifugal pump, and shows how the various conflicting formulae ordinarily given are essentially the same in result.

The experiments with the six-inch vertical centrifugal pump were arranged specially to investigate the effect, on the discharge and efficiency, of the number and shape of the vanes of the impeller of the pump. For this purpose the impellers to be compared were made of the same general size so as to be easily placed in the same pump casing, while the number and shape of the vanes of the impeller were varied. The general shape of the vanes used was radial, and radial with curved entrance, while the number of vanes for each shape was varied, being six, twelve and twenty-four in number. The form of water way between the vanes was also varied by increasing the thickness of the outer ends of the vanes. The comparison of the results of the experiments thus show the effect on discharge and efficiency of the pump of practically all possible modifications of the simple radial vane. Additional experiments are now being made which will show the effect on discharge and efficiency of curving the vanes of the impeller both forward and backward, and also of varying the form of the pump casing.

The importance of the subject is such that the investigation has been laid out on broad lines and will last several years. It is hoped that the results of the investigation, when completed, will be of material aid to a thorough understanding of the subject.

The general scope of the investigation has been laid out by Daniel W. Mead, professor of hydraulic and sanitary engineering, while the details of the investigation and writing of the bulletins have been performed by Mr. C. B. Stewart, C. E. Copies of the first bulletin, University Bullentin No. 173, may be obtained by addressing the Secretary of the Board of Regents of the University of Wisconsin, Madison, Wis.

Educational Course of the N. Y. Edison Co.

The lecture course on electrical engineering provided by the New York Edison Company for its employees has proven an effective means for raising the technical status of the employees. The lectures are given by Prof. Sydney W. Ashe under the auspices of the Association of Employees of the New York Edison Company, a special lecture committee having been appointed consisting of Messrs. W. I. Donshea, W. T. Fernandez, W. H. Lawrence, A. H. Lawton, Alexander Maxwell, chairman, and Samuel Ring, secretary. Twelve of the lectures from a series of 25 have thus far been completed, and the total attendance has been about 4000 men.

In carrying out the general scheme of these lectures, it has been found advantageous to distribute to all employees a syllabus giving dates, topics, etc., for each lecture, as well as a general outline of each lecture with experiments. The course is general, extending over the electrical field from the elements of magentism to the subject of alternating-current measurements. Wherever possible the applications of the theory to the practice of the company has been made plain. With each lecture numerous experiments are performed, and where possible specific values are obtained by means of ammeters, voltmeters, galvanometers, thermopiles, etc., whose readings are projected on the screen by means of an electric lantern.

Extensive arrangements have been made in the auditorium of the Edison Company for these lectures. The problem of demonstrating to an audience of over 400 men, which the auditorium accommodates, is difficult, and all experiments have, therefore, been performed either on the screen or on a large scale on the lecture table. The lecture table is provided with direct and alternating-current outlets, as well as an outlet for illuminating gas. It is massive in construction so that motors up to 5 horse-power in ratings may be operated upon it. A large blackboard was constructed which could be raised to a considerable height so that all could be able to see whatever was written upon it.

The accompanying illustrations show the general arrangement of lantern, screen, table, blackboard, etc., for a lecture on the arc lamp. Direct and alternating open and enclosed arcs, with a flaming arc and a magnetite arc, were operated so that comparisons of distribution, color, efficiencies, etc., could be made with incandescent and mercury-vapor lamps.

For each lecture numerous typewritten notices are posted in advance by the lecture committee calling attention to the lectures, giving directions for study and dwelling upon the advantages of attendance.

Each lecture is delivered twice, at 1:30 p. m. and 8 p. m., on the same day, so as to give all men on all watches an equal opportunity to attend. While the number who attend the afternoon lectures is not large (about 40), still the officers believe that this policy is necessary in order to be fair to all.

The expense associated with these lectures is borne by the Edison Company, the course being free to all employees. The various text-books recommended to be used in conjunction with the course have been purchased by a great many, and in addition several sets of these books have been purchased by the management of the company and placed at the disposal of the men in the library. This library contains practically all of the modern standard electrical books, as well as the various technical publications. It is one of the most complete libraries of its kind in New York City. This library is conveniently located in the same building as the auditorium, so that those who attend the lectures can come early and study before the lecture. The library possesses an additional advantage in that special references made during a lecture may be subsequently looked up. The lectures have proven of much interest to the men, have stimulated study and self-improvement of many, have resulted in the propounding of many questions, and have been warmly appreciated by the men.

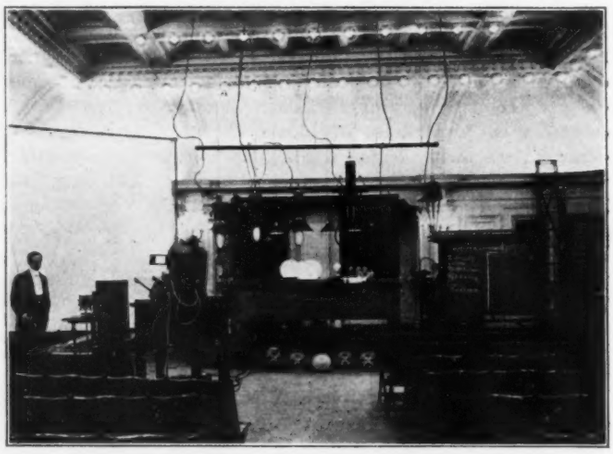


FIG. 2.—ARRANGEMENT OF APPARATUS FOR LECTURE ON ARC LAMPS.

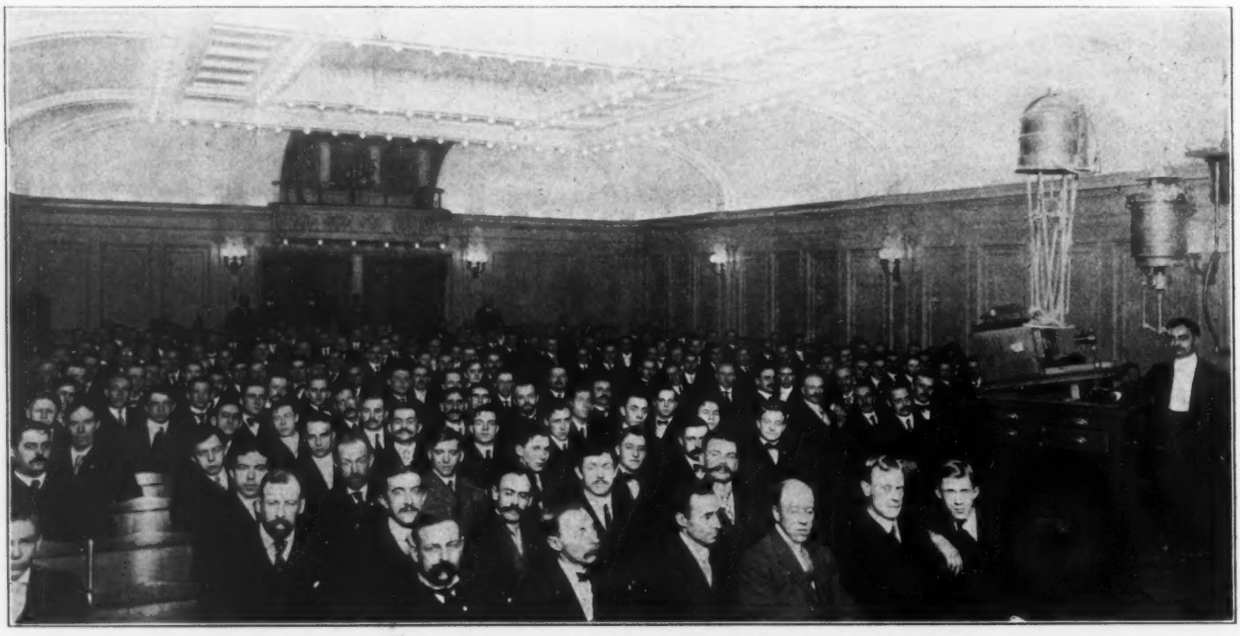


FIG. 1.—GENERAL VIEW OF EDISON AUDITORIUM DURING LECTURE ON ARC LAMPS.

Use of Means of Communication.

The use of means of communication should be taken as one measure of civilization. In this respect the United States appears to compare favorably with Europe. An interesting summary in the New York *Evening Post* gives a few figures on the subject. In the last year for which the complicated figures are available, that is, the year ending Jan. 1, 1905, it appears that the messages sent by post, telegram, and telephone per each one thousand inhabitants were about three times more numerous in the United States than in Europe.

Of letters and postal cards each one thousand persons sent 66,719, as compared to 29,554 for Europe. In the matter of telegrams each one thousand Americans sent 1,099 messages for every 731 transmitted by Europeans. But it is in the matter of telephonic messages that the inhabitants of the United States far surpassed those of the Old World. While each thousand of population in the old country sent 7,364 messages by the telephone, each one thousand Americans sent 44,344, or more than six times as many.

The tabulated figures for the two divisions per one thousand inhabitants are:

	Europe.	U. S.
Letters and postal cards	29,554	66,719
Telegrams	731	1,099
Telephone communications	7,364	44,344

In the United States, as appears from the above, telephone messages were nearly as common as postal communications, and forty times as common as telegraphic messages. In other words, the telephone was the greatest factor in commercial inter-communication. In every class except the comparatively insignificant one of telegrams, the United States has shown a greater increase over the preceding year than has Europe.

Postal communications in this country gained 5.5 per cent, as compared to 4.4 per cent abroad, and while Europe's increase in telegraphic messages was 4 per cent, as compared to 1 per cent here, the increase in American telephone messages was 12.9 per cent, as compared to 11.9 per cent. And that does not take into consideration the fact that the population of Europe is about five times that of the United States.

Altogether, the number of messages for each 1,000 inhabitants was almost three times as great in this country as abroad. For each 1000 inhabitants Europe sent 37,649 messages, as compared to 112,162 in this country. Where the average European in the course of a year sends 30 letters, less than 1 telegram, and 7 telephone calls, the average American writes 66 letters, sends 1 telegram and 44 telephone calls.

The figures showing the state of "telephonic develop.nent" in this country and abroad are interesting. To obtain the percentage of telephonic development an arbitrary standard is adopted. All the population under twenty years is eliminated as not coming within the class of possible subscribers. Of those left, one-half are arbitrarily eliminated, and the remainder regarded as possible subscribers. The telephonic development, then, of any country is indicated by the percentage of these possible subscribers who already have telephones.

In this telephonic development, according to the latest figures, America far outstrips the world, with an average of 9.3 per cent. Sweden is the nearest competitor, having a telephonic development of 8.1 per cent, but the average for all Europe is only 1.4 per cent, or less than one-sixth that of the United States. Hungary, for example, has a development of only one-half of 1 per cent; that is, only one possible subscriber among every 200 has a telephone. The figure for France is 1 per cent, for the German Empire 3.3 per cent, for Great Britain 3.5 per cent, with other countries occupying intermediate positions between Hungary, the minimum, and Sweden, the maximum.

Perhaps American superiority in regard to the use of the telephone is better shown in regard to the total number of conversations as compared to those in Europe than in any other way. The total population on which these figures are based is 409,557,325 in Europe as compared to 85,568,000 in the United States, and the number of possible subscribers as established by the already explained arbitrary measurement is 118,771,624 abroad as compared to 23,956,000 in this country. Yet with the population in Europe five times as great as here, the total messages sent during the year were practically equal in the two countries, giving America a superiority of more than five to one.

According to the figures for the last year available, Americans used the telephone 3,680,000,000 times as against 3,114,541,691 time abroad. In Europe, with its five times greater population, there were 1,726,880 subscribers as compared to 2,241,367 in the United States.

Statistics of American Railroads.

The twenty-first report of the Interstate Commerce Commssion gives some very interesting data in regard to the railroads of the United States. "On June 30, 1906," says the report, "the total single-track railway mileage in the United States was 224,363.17 miles, or 6,262.13 miles more than at the end of the previous year."

There were in the service of the carriers 51,672 locomotives, the increase being 3,315. The total number of cars of all classes was 1,958,912, or 116,041 more than for the year 1905.

The number of locomotives and cars in the service of the railways aggregated 2,010,584, of which 1,827,789 were fitted with train brakes, or an increase for the year of 186,394, and 1,989,796 were fitted with automatic couplers, or an increase of 118,206. Of 1,837,914 cars in the freight service on June 30, 1906, the number fitted with train brakes was 1,689,141, and with automatic couplers 1,820,854.

The reported number of persons on the pay rolls of the railways in the United States on June 30, 1906, was 1,521,355, which is equivalent to an average of 684 employees per 100 miles of line.

The total amount of wages and salaries reported as paid to employees during the year ending June 30, 1906, was $900,801,653; but this amount is deficient by more than $27,000,000, because of the loss of railway records in the San Francisco calamity.

On June 30, 1906, the par value of the amount of railway capital outstanding was $14,570,421,478, which is equivalent to a capitalization of $67,936 per mile for the railways in the United States.

Of the total capital stock outstanding $2,276,801,333, or 33.46 per cent, paid no dividends. The amount of dividends declared during the year was $272,795,974, being equivalent to 6.03 per cent on dividend-paying stock.

The number of passengers carried by the railways in the year ending June 30, 1906, was 799,507,838, this item being 60,673,171 more than for the year ending June 30, 1905.

The number of tons of freight carried was 1,631,374,219, which exceeds the tonnage of the year 1905 by 203,642,314 tons.

The gross earnings of the railways in the United States from the operation of 222,340.30 miles of line were, for the year ending June 30, 1906, $2,325,765,167, being $243,282,761 greater than for the year 1905. Their operating expenses were $1,536,877,271, or $146,275,119 more than in 1905.

Five thousand passengers and employees were killed, and 76,286 injured on the railroads during the year of report, or about ten thousand more than in the previous year.

Economy of Electric Elevators.

The gearless, one-to-one, traction, electric elevator was described in a paper by Mr. J. D. Ihlder, of the Otis Elevator Company, New York, read before the Western Society of Engineers, electrical section, at Chicago, Jan. 10. Mr. Ihlder was not present on account of illness, and his paper was read by Mr. H. Russell Smith, of the Otis Elevator Company, Chicago. The paper was illustrated by stereopticon views. This is the type of elevator employed in the new 42-story Singer Building, in New York City. In the discussion which followed the reading of the paper Mr. Smith cited tests made on an

elevator in actual service in a large office building, in which the elevator averaged 20 miles per day for a week and took 2.67 kw-hours per car-mile.

Mr. S. M. Bushnell, engineer of the contract department of the Commonwealth Edison Company, Chicago, said that an electric elevator load was at first looked upon with suspicion by central-station men because of its extreme fluctuations. With a large number of elevators connected to the system, however, these fluctuations were smoothed out and became negligible. The elevator load was now one of the best classes of motor load for a central-station company. The electric elevator formed the last link in a chain of complete electric service for office buildings. With successful electric elevators for high speed and high lifts, the entire power service of a building could be supplied electrically either from a central station or from an isolated electric generating plant. He gave it as his experience, based on extended investigation by his company, that the kw-hours required per car-mile for purely electric elevators was about half that required by hydraulic elevators with the pumps operated by electric motors.

Mr. John Mabbs referred to the elevators of his invention used in the Board of Trade Building, Chicago. In these elevators the motor and mechanism form the counterweight, this counterweight being driven up and down by a rack and pinion. These elevators have made 35,000 miles in five years, consuming 3.44 kw-hours per car-mile. The cars had 36 sq. ft. floor space. The service was of the severest nature. The old elevators in the same building, which the Mabbs elevators displaced, took 5.35 kw-hours per car-mile. Repairs on the Mabbs elevators have averaged $83.24 per year per elevator.

Circuit-Breaker Litigation.

Judge Ray, of the United States Circuit Court for the Southern District of New York, handed down on Jan. 8 a decision in a suit of the Westinghouse Electric & Mfg. Company against the Conduit Electrical Mfg. Company of New York, sustaining the validity of a patent on an automatic circuit-breaker, granted Sept. 26, 1899, to C. Wright and C. Aalborg. This patent was the subject of prior litigation in the United States Court of the Third District. In the lower court of the Third District the claim of infringement of the patent was denied on the ground that while the defendants' device secured the early closing and delayed break "by a shifting movement of both the shunt terminal and piece," the complainant accomplished the same result "through a stationary shunt terminal and a moving shunt piece actuated by a long arm pivoted to the main contact member near the toggle joint," and consequently there was no infringement. This decision was reversed in the Circuit Court of Appeals, which held that the pivotal connection is essential to practical operation of the patented device and was infringed by the defendant.

In the present case the defense was that the device in suit was anticipated by prior patents granted to Larsen, to Potter and to Packard, and that the mechanism in the alleged infringing device was not the equivalent of the mechanism in the patented device. In discussing the question of patentability, the opinion states that "we are dealing with a device which has to do with electricity, the power of which is so tremendous as to be appalling, and one purpose of which is to prevent accident and destruction;" and that "the control of electric current and devices, therefore, is an art as yet in its infancy, probably." The opinion also states that "when an invention has been extensively introduced and has met with success and large sales, we have, sometimes, from this fact alone persuasive evidence of patentable invention. It is sufficient to turn the scales, as the courts have frequently held." The final conclusion of the court was that patentable invention is disclosed in the claims.

As to difference in construction, the court held that the defendants' circuit-breaker answers literally the terms of the claim in the suit except that the movable shunt-carbon is mounted on a spring arm which extends upward from the laminated contact member instead of being actually pivoted to a rigid arm extending up from this member. The function of the movable carbon in the complainants' circuit-breaker is to adjust the current contact between the stationary and movable carbons, and to allow the main contact to close and open before the carbon contacts are open, and this, it is declared, is the sole function of the defendants' spring-mounted carbon. In the defendants' device, the axis of motion of the movable carbon is not confined to the line of a pin or pivot, as in the complainants' device, but is distributed along the spring arm. This, however, is held to be immaterial as the function is the same, and the mode of operation of this part of the device is substantially the same. The final conclusion is that the defendants by substituting an equivalent did the same thing Wright and Aalborg had done and protected by their patents, and the defendants' device is not differentiated from the complaintants' by the mere substitution of a well-known equivalent. The claims 2 and 5 of the patent were held valid and declared infringed by the defendants and a decree in accordance was ordered.

Annual Meeting of the Illuminating Engineering Society.

The annual meeting of the Illuminating Engineering Society was held on Jan. 10 in the rooms of the Electrical Club, 14 Park Place, New York City. The meeting was preceded by an informal dinner. The report of the finance committee showed that the society has a surplus of a few hundred dollars, the income from advertisements in the *Transactions* having prevented a deficit. The committee made a strong plea for an increase in membership, which would place the society on a better financial basis so that it would not have to depend on the receipts from advertisements. The latter fund could be devoted to research and other work. The report of the advertising committee showed that the income from advertisements was about $800.

After the reading of the reports Dr. C. H. Sharp delivered his presidential address.

The address of President Sharp was confined largely to an account of the experience during the past year in the working of the society under its federal organization. This was found to be far from satisfactory, owing to the fact of non-attendance at council meetings of the vice-presidents representing the several societies, and to neglect on the part of these in communicating with the council in regard to such matters as should be brought before it, or to keeping in such close touch with the affairs of the society at large as to be able to present to the sections they represent the broader views of the affairs of the society that the council must always take. While the *Transactions* are dependent upon the activities of the local sections for the supply of papers and the sections are to a considerable extent dependent upon each other in this regard, it was stated that during the past year nearly all sections have fully met their responsibility in this matter, as is shown in the papers and discussions printed in the *Transactions* during the year. President Sharp stated that the membership at the present time numbers 944.

After the address the report of the tellers appointed to canvass the results of the annual election was received. This report showed that the officers elected for the ensuing year are as follows: President, Dr. Louis Bell, of Boston, Mass.; vice-presidents, Messrs. Arthur Williams, of New York, and C. E. Stephens, of Pittsburg, Pa.; secretary, Mr. V. R. Lansingh; treasurer, Dr. A. H. Elliott; directors, Messrs. W. H. Gartley, W. H. Eyre and Bassett Jones, Jr.

Dr. Bell, after being presented by Dr. Sharp, made an optimistic address, outlining his reasons for the belief that the society has a great future before it and stating that it was essential among other things to increase rapidly the membership. There followed a broad discussion on the future of the society and the policy it should adopt with regard to the

character of papers to be presented. Mr. Arthur Williams, of the New York Edison Company; Mr. John Gilchrist, of the Commonwealth Edison Company; Mr. F. J. McGuire, Mr. W. H. Gardiner, Dr. A. H. Elliott and others participated in the discussion. The meeting was a most interesting one and did not adjourn until a very late hour.

Helion Incandescent Lamp Filament Patents.

Three patents were issued Jan. 14 to Mr. Walter G. Clark on processes for making incandescent lamp filaments of the type consisting of a combination of silicon and carbon. The deposits of silicon have been obtained by the decomposition of chlorides, and the object of the patent is to obviate the difficulty that has been experienced in getting a uniform product and to prevent the chlorine once free from combining with the silicon. The first of the several patents describes a process wherein a carbon filament is placed into a receiver containing a small quantity of mercury, after which a silicon chloride, such as a tetra-chloride and also a gas which contains carbon, are introduced. When the current is passed through the filament the chloride is decomposed and the silicon deposited upon the carbon, and the free chloride combines with the mercury. The second patent covers the use of the carbon gas referred to above, the claims being for the mixture of marsh gas and an olefiant gas, or marsh gas, olefiant gas and carbon dioxide. The third patent states that the hydrocarbon gas may be some form of illuminating gas, but is preferably the marsh gas. When the deposition on the filament takes place the silicon and combination of silicon and carbon, which is a dense, non-porous combination, enter the pores of the carbon base, combine with and build up on the base, so that the latter becomes a combination of silicon and carbon, which gradually merges near the surface into a substance having characteristics similar to those of silicon.

Grounding of Alternating Systems.

As chairman of the National Electric Light Association Committee on the grounding of alternating current systems, Mr. W. H. Blood, Jr., called a conference of the committee to consider this subject on Jan. 7, the meeting being held at the offices of Stone & Webster, in Boston. There were present at this conference representatives of the National Electric Light Association, the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies, and the National Electrical Inspectors' Association.

The N. E. L. A. committee had formulated its ideas on the subject in advance, and the conference approved largely the suggestions offered, although making some slight modifications. The final draft will be presented to the Underwriters for action at their meeting in March.

The N. E. L. A. committee has suggested that the grounding of transformer secondaries up to 150 volts be made compulsory, and that above 150 volts the ground shall not be permitted. It has also added a provision for making ground connections through driven pipes, which is an entirely new feature in the Code; and it has specified how these pipes shall be tested to see whether the ground is satisfactory and adequate.

CURRENT NEWS AND NOTES.

ELECTRICITY FOR TSINANFU.—Advices received in Washington state that owing to the inability of the present plant at Tsinanfu, Shantung, to supply the electricity needed by the city the local authorities have evolved a scheme of building a plant to cost $160,000. Permission to organize a company for this purpose has been asked of the Central Government at Peking.

TIENTSIN STREET RAILWAY.—In a recent report by the Belgian concessionaires for the electric street railway in Tientsin, it is shown that while the lines do not as yet pay much, the Chinese are riding in ever-increasing numbers, and in a few years the company expects to obtain handsome returns. At present much is being done to extend the lines in the Chinese city, and in the French, Italian, and Austro-Hungarian concessions.

BROOKLYN EDISON INCREASE.—On January 1, 1907, the Edison Company had connected to its system the equivalent (in lamps, motors and all other electrical appliances) of 1,167,595 16-candle-power incandescent lamps. During the year this has been increased by approximately 200,000 such equivalents, or about 17 per cent. The company has been directing its attention particularly toward residential lighting, and has featured house wiring in its campaign for more business.

WESTERN SOCIETY OF ENGINEERS.—The electrical section of the Western Society of Engineers elected the following efficers at its meeting Jan. 10, 1908: Chairman, D. W. Roper, assistant chief operating engineer, Commonwealth Edison Company; vice-chairman, H. R. King, engineer, Western Electric Company; member of committee to serve three years, E. N. Lake, of the Board of Supervising Engineers, Chicago Traction. These officers are for the electrical section only. Mr. P. Junkersfeld, of the electrical section, was elected second vice-president of the society at the recent election.

BRITISH PATENT LAW.—U. S. Consul Albert Halstead, of Birmingham, notes that the new British patents and designs act became operative Jan. 1, 1908. This act, which has already been summarized in these pages, makes compulsory the working "to an adequate extent" in the United Kingdom of patents having the benefit of the protection of the British patent laws, and will force the manufacture in the United Kingdom of many articles now made in the United States for export to the United Kingdom. It will bring work to British labor, and that is what it is intended to do. Its effect will be most striking in connection with the manufacture of automatic shoe machinery.

WIRELESS RULES RATIFIED.—Ambassador Tower has cabled the State Department from Berlin in answer to an inquiry as to the number of countries that had undertaken to execute the provisions of the Wireless Telegraphic Convention of 1906, as follows: Belgium, Denmark, Mexico, Holland, Norway and Roumania have deposited with the German Government ratifications of the Wireless Telegraphic Convention. Argentina and Brazil have officially approved the convention, and are ready to deposit the ratifications. France awaits the ratification of Great Britain, while the German Government has introduced in the Reichstag a bill to authorize ratification.

WIRELESS IN CARIBBEAN.—U. S. Consul Drew Linard, of Ceiba, reports that the rumor that a series of wireless stations is to be erected at several ports on the Caribbean coast has been confirmed, and adds: "The United Fruit Company has negotiated with the De Forest Wireless Telegraph Company for the establishment of stations at Belize, Puerto Barrios, Puerto Cortez, and Ceiba, probably extending the system as far south as Port Limon, Costa Rica. It is assured that wireless communication between these points and the United States will be in operation by the first week in February. The United Fruit Company will serve the public, but subject to censure of all messages, retaining the privilege of refusing for transmission such messages as may appear prejudicial to their business interests. This exception to public service is due to the constant competition among the several steamship lines operating in the fruit trade between the United States and Central American ports. The business men of Ceiba are much elated, and welcome the advent of the wireless as a factor of inestimable value to them in their commercial relations with the United States."

ELECTRICITY IN GERMANY.—U. S. Consul Norton, at Chemnitz, Germany, in a review of industrial conditions, states that all the electrical industries "continue to manifest an exceptional degree of activity, and there are no indications of a setback in 1908."

ELECTRIC HEATING DEVICES.—The North Shore Electric Company, operating in the suburban territory around Chicago, has succeeded in making the demand for electric heating appliances so common that in Evanston, the largest suburb which it serves, two stores handle electric irons, chafing dishes and toasters. One of these stores is a hardware store, the other a general department store.

MUNICIPAL PLANT AT PENNSBURG, PA.—In the description of the municipal electric lighting plant at Pennsburg, Pa., published in the Jan. 4 number, credit should have been given and is here extended to Mr. S. S. Edmands, Professor of Electrical Engineering in the Pratt Institute, Brooklyn, and to Mr. F. G. Ortt, of Brooklyn, the designer and contractor, respectively, of this very interesting plant.

AN ELECTRICALLY HEATED HOTEL.—The Eagle Hotel at Grand Rapids, Mich., has taken advantage of the low rates offered by the Grand Rapids-Muskegon Power Company, and has twenty-seven rooms equipped with electric radiators as the only source of heat. The halls are heated by steam. A 10-cent theater in Grand Rapids is also being heated electrically by means of air heaters located in registers under the floor.

UNDERWRITERS' LABORATORIES.—A pamphlet just issued by the Underwriters' Laboratories, 382 Ohio Street, Chicago, Ill., gives information relating to the nature of the work done in the laboratories and the terms and conditions under which it conducts tests of fire appliances and materials. Illustrations are given of the different departments of the laboratory and the various inspection labels are reproduced in colors. A list is given of the staff of the laboratory and of the engineers in charge of branch offices in 18 cities throughout the country.

SAFETY IN MINES.—Mr. L. C. Huber, an engineer, of Louisville, Ky., has written to Governor Willson of Kentucky and to President Roosevelt, strongly advocating the exclusive use of incandescent lamps in mines, as the only real safety lamps, and as a preventive of such terrible "accidents" as have occurred lately. The mine disasters of this season in the United States show a death roll of 3000, and Mr. Huber asserts that the government should force electric lighting on the mine owners to stop such fearful loss of life, just as it did the use of safety couplers on the railroads.

MUNICIPAL PLANT TROUBLES.—Word comes from St. Joseph, Mo., that Walter C. Stewart, superintendent of the Municipal Lighting Plant, with which he has been connected 21 years, has been indicted on the charge of obtaining money by false pretenses. Charles W. Waller, foreman, is under arrest, and other indictments are out. In its report the grand jury states that men long dead are still on the pay roll. In one instance a schoolboy, who worked a few hours at the plant on Saturdays, was drawing $50 a month. The jury says that St. Joseph has been defrauded out of thousands of dollars by padded pay rolls.

VARIABLE-VOLTAGE GENERATOR.—A patent granted Dec. 17, to Mr. K. A. Pauly discloses means for automatically preventing too rapid a change in the field strength of a variable-voltage generator supplying energy to direct-current motors It is well known that when the voltage inpressed upon the armature of a separately excited direct-current machine is increased rapidly excessive current is taken from the generator, while if the generator voltage is rapidly decreased the motor will return energy to the generator. The inventor places a short-circuited winding on the generator field-pole, so that the rate of change of the generator field magnetism is properly damped.

NIAGARA TRANSMISSION LINE.—Construction has been begun on the first section, 28 miles long, of the 60,000-volt transmission line, which will carry Niagara Falls current to the Buffalo, Lockport & Rochester Railway. This road is a high-speed interurban between Lockport and Rochester, through connection with Buffalo over the International Railway being contemplated. Construction is well advanced and cars will be run over a finished portion of the road within the next few weeks. The transmission line connects with the 60,000-volt lines of the Ontario Power Company near South Greece, and runs thence across country to Albion on the Buffalo, Lockport & Rochester Railway; it then parallels the railway.

DISCOVERY OF ELECTROMAGNETIC INDUCTION.—A recent accession to the A. I. E. E. library, entitled "Recherches et Expériences sur l'Electricité," which consists of a collection of eight papers published between 1825 and 1827 by Daniel Colladon, the Geneva physicist, includes a short paper on an experiment on electromagnetic induction made in 1825, five years prior to the great discovery of Faraday. The experiment was similar to the later and successful one of Faraday, but gave negative results for the reason that the galvanometer employed was not of a type to respond to instantaneous currents, and Colladon states that he did not suspect that the induction had only an instantaneous effect.

A NIAGARA IN BRAZIL.—U. S. Consul George A. Chamberlain, of Pernambuco, sends a comprehensive description of the Paulo Affonso Falls and the San Francisco River, situated in that part of Brazil. The falls are 230 miles from either Pernambuco, which has a population of 200,000, or Bahia, with 230,000 people. The average flow of the river is 1000 cubic meters per second, and between Jatoba and Piranhas, a distance of about 65 miles, the fall is 756 feet, 400 of which takes place in the rapids, extending about 15 miles. This vast undeveloped water power will become in time the nucleus of a great industrial region. Mr. Chamberlain's report may be consulted at the Bureau of Manufactures in Washington.

LIGHTING FIXTURES IN THE HARRISBURG CAPITOL.—In order to increase the efficiency of the smaller chandeliers in the Capitol at Harrisburg, it has been decided to turn them upside down. The chandeliers are in the smaller series of brass and bronze affairs which cost between $600 and $1,000 each. They are hung profusely in various offices and are fitted with semi-transparent shades, as in ordinary open-flame gas practice. As pointed out in our article a year ago describing the lighting of the Capitol, the fixtures are so massively bronze that most of the light is absorbed by themselves, in most cases necessitating the use of desk lamps. The plan of reversing them is said to have resulted in much better illumination.

SCIENTIFIC TELEPHONE RATES.—Mr. George Albree, appointed by the Massachusetts Highway Commission to examine the affairs of the New England Telephone & Telegraph Company, has reported exhaustively to the board, arriving at these conclusions: 1. If the present policy of treating the entire territory of the company as a unit is to continue no separation of accounts on territorial lines or areas is necessary. 2. If, however, any attempt is to be made to correct any irregularities or inequalities in existing rates by substitution of scientific methods of determining rates on cost, for one of expediency, in any exchange, or for any class of service, it at once disturbs the established policy and the separation of accounts is inevitable. Whichever of the courses is determined later best to meeting existing conditions, the commission will be confronted with the fact that whether treating the company as a unit, or as an aggregate of units, the three elements, cost of plant, cost of maintenance, and cost of operation, are yet to be determined.

Japanese Hydro-Electric System.

A HYDRO-ELECTRIC generating and transmitting system utilizing energy from the Hitaka River, in Japan, which was recently placed in service, possesses many points of interest to electrical engineers. Not the least interesting feature is found in the location of the generating station, which was so nearly inaccessible that the cost of conveying the generators and turbines over the last 20 miles of the route was equal to the initial cost of the equipment. For ten miles use was made of special floats for the machinery, which was drawn by hand for the other ten miles.

The turbine station makes use of a total fall of 76 ft. in a distance of 3 miles of the above river. The hydraulic development was rendered comparatively simple, but none the less interesting, by reason of the fact that the particular 3 miles

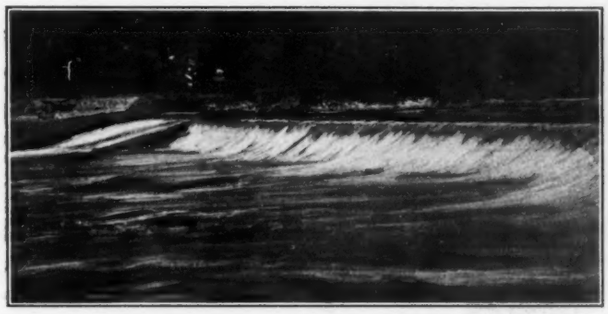


FIG. 1.—VIEW OF DAM.

selected covers an almost closed horseshoe bend, so that a tunnel 600 ft. in length and a 220-ft. canal were sufficient to connect the higher elevation with the lower. The tunnel and canal serve a double purpose. Not only do they guide the water to the turbines, but this water acts as a means of conveyance for rafts of timber which are floated down the Hitakagawa and shunted from the entrance to the flumes along a special timber incline. The timber rafts, which in some cases are 240 ft. in length, are 6 ft. in width. The tunnel is almost circular in cross-section, being 16 ft. in height and 16 ft. in width, and is provided with two steel lock gates; the water is kept at a depth of 8 ft. In the canal the water depth is also 8 ft.; the width at the bottom is 16 ft., and at the top it is 20 ft.

The dam, which serves for deflecting the water of the river

FIG. 2.—TUNNEL EMPTYING INTO CANAL.

into the tunnel, although it is only 4 ft. above the original water level of the river on the up-stream side, differs greatly in design from dams of similar height in this country. The problem of constructing a dam across the Hitakagawa was rendered difficult by reason of the violence of the stream during the flood season, when heavy timbers and large boulders are swept along with great rapidity. The dam is a stone and concrete structure 280 ft. long and 6 ft. wide at the top. The up-stream slope is .25 to 1, and down-stream slope 2. to 1, and is connected with circular curve to the bottom rock; the dam is 22 ft. in height on the down-stream side.

The water in the canal has three outlets, namely, through a sluice gate to feed the fields of Kawakami village, through the penstock to the turbines, and along an overflow spillway. This spillway is terraced to minimize damage from the energy of the water. The steel penstock is 9 ft. in diameter and 220 ft. long.

The power house is a brick building having main dimensions of 40 ft. x 120 ft., with an extension 15 ft. x 30 ft. The

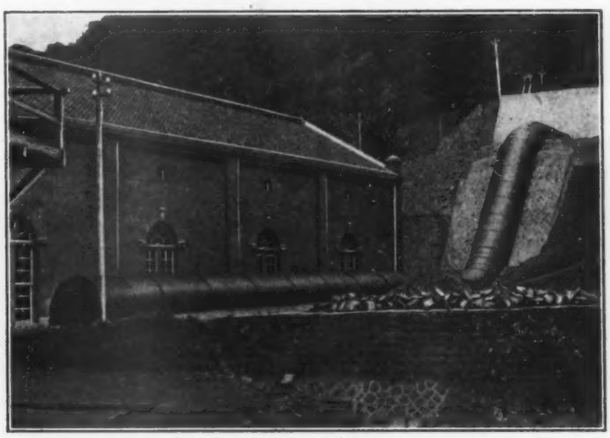


FIG. 3.—VIEW OF 9-FT. PENSTOCK.

hydraulic equipment consists of four Francis reaction turbines made by the Ateliers de Constructions Mecaniques, Vevey, Switzerland. Each turbine is directly coupled to a 625-kw, three-phase, 12,000-volt, 50-cycle generator with revolving field. The generators are 16-pole machines, and run at 375 r. p. m.; they were built by Brown, Boveri & Co., Baden, Switzerland.

The e. m. f. of the generators is sufficient for transmission over the 26 miles separating the power house from the sub-station in Wakayama. The latter is a city 40 miles from Osaka, containing a population of about 70,000 people. The sub-station contains oil-insulated, water-cooled transformers for reducing the e. m. f. to 3000 volts, at which value the energy is distributed to the various customers. Some few motors are operated at 3000 volts, but most of the motors are wound for 220 volts, while the lamps receive energy at 100 volts. Thus additional transformers are installed on the customers' premises for delivering the required e. m. f. A portion of the energy is used for operating the railways between Wakayama and

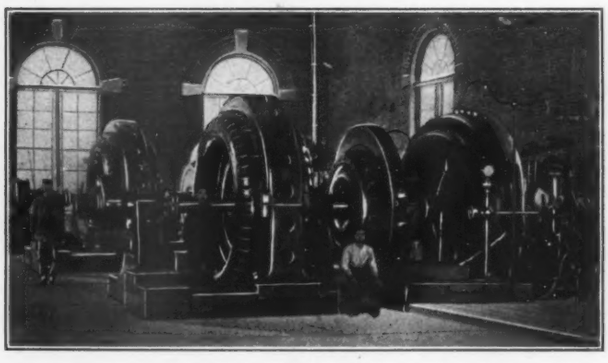


FIG. 4.—VIEW OF INTERIOR OF GENERATING STATION.

Wakaura, a place famous for its beautiful scenery, a distance of 5 miles, and between the latter place and Kuroye, a distance of 3 miles. About half of the output is used for lighting.

The above-described hydro-electric equipment was designed and installed by Saiga & Company, of Osaka, Japan. We are indebted to Mr. S. Mitsui, chief engineer of the company, for the information contained in this article.

The Design of Prepayment Watt-Hour Meters.

By Arthur Pestel.

THE difficulties in the design of a reliable prepayment watt-hour meter which can be trusted in every respect are so many that it may be of interest to consider systematically the more important points involved in this type of instrument, with a view to indicating in what way the difficulties may be overcome.

An electrical prepayment meter consists in general of a watt-hour meter to which a time switch with a prepayment device is connected.

In the design of such an instrument the following appear to be the most important points to be considered: (1) The main circuit should be broken when the energy paid for has been consumed. (2) The device should show the consumer how much of the money he has placed in the meter is still to his credit. (3) There should be an adjustment for different rates of payment. (4) The instrument should be absolutely fool-proof. (5) It should be cheap.

In considering the first four points, the common watt-hour meter will be accepted as a standard instrument which cannot be altered in its main features.

The greatest difficulty will be encountered in the design of the circuit breaker because there is required a contact switch which must be automatically released when the energy paid for has been used.

It will be necessary to find a switch which will require very little power to release. In mechanical construction the switch should be very light, but strong, and it may be advisable for the designer to consider first the main principles of construction on existing knife, brush, spring, carbon, mercury switches, etc., and to ascertain which will cause the least friction and require but little power to release.

A simple and almost frictionless device is found in the mercury switch, but utmost care must be taken to adapt it for shipment if it should not be found more convenient to place the mercury into the meter after the latter has reached its destination. A switch from which the mercury has almost no possibility of escape might be made as shown in Fig. 1. Here an iron fork slides through bushings in a case made of insulating material. The mercury in the basins has no means of escape, even if the case should be placed upside down,

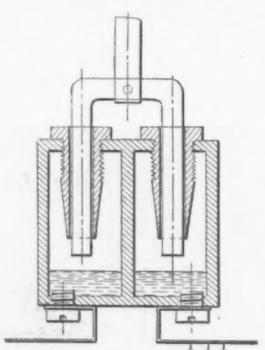


FIG. 1.—MERCURY CONTACT SWITCH.

as the bushings are made much longer than the depth of the mercury. There is, however, a possibility that a few drops might be able to go through the bushings in which the fork slides if the switch should be shaken violently. If this should happen, it will be necessary to place this switch in a separate chamber, at the back of the meter for instance, and have it arranged in such a way that the mercury cannot find its way to the other mechanism.

As, up to the present time, it has not been possible to do without a switch in a prepayment meter, it will be assumed that this device is used and it will now be necessary to seek the simplest, surest and cheapest way to release the main cut-out.

As the release can be obtained by either mechanical or electrical means, and as this again can be done either directly or indirectly there are the following four cases of which the last three seem to be the most practical:

(1) In releasing the cut-out directly, by mechanical means, the prepayment mechanism is connected to the registering device of the watt-hour meter in a mechanical way and is supposed to overcome all friction and release the cut-out directly. However, as it is nearly impossible to overcome all

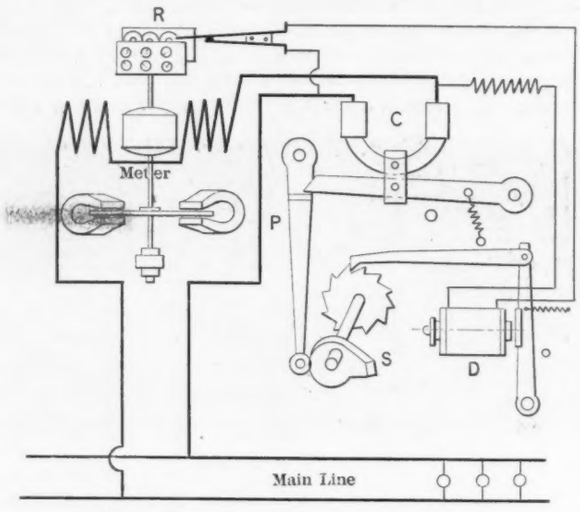


FIG. 2.—COIN-CONTROLLED MECHANISM.

friction, and as thus far no satisfactory results have been, and perhaps never will be, attained, it may be sufficient here merely to mention this case without going into further details.

(2) The release of the cut-out directly, that is, without depending upon any additional source of power, as spring for instance, but by electrical means, can be arranged in such a way that the prepayment mechanism with cut-out is either combined with the watt-hour meter or is a separate instrument. In either case the release of the cut-out could be accomplished by the operation of an electric relay. This relay must be actuated with as little power as possible in order to have the breaking spark of the relay switch reduced to a minimum. This switch would have to be used in connection with the registering device of the watt-hour meter, and be opened and closed in accordance with a certain number of passing watt-hours. As the relay will, therefore, make a constant number of strokes during one kw-hour, it will be necessary merely to move a simple mechanical device away from the releasing point of the main cut-out, when placing a coin in the meter. For each coin this device would have to be moved a certain distance, which then would require a certain number of strokes of the relay to return the former to the releasing point, in order to open the main circuit.

Fig. 2 shows the principle of this arrangement. In this diagram C is the main cut-out, held in position by lever P, which is operated by some mechanical device S moving back and forth by either the coin or the relay D through the contact at R, as described above.

(3) The release of the cut-out indirectly by mechanical means can be made in such a way that the prepayment mechanism with switch is either separate or combined with the watt-hour meter.

In releasing the cut-out indirectly, an additional source of power will be required, which could be in the form of a spring or weight. These could be arranged as mechanical relays, assisting the watt-hour meter in releasing the main switch. By using a clock spring in connection with a train of wheels, which, by means of an escapement and escapement-wheel, for instance, are connected to the registering device

of the watt-hour meter, the registering device will not require very much power to operate the escapement, while the release for the main switch could be in direct connection with the clock spring and thus have sufficient energy to break the circuit. If a weight should be used instead of a spring, it could be raised and held in position until the meter releases it.

Fig. 3 shows such an arrangement. Here lever L stands in a raised, nearly vertical position and is held by a stop S which moves forward when a coin is inserted. As soon as this

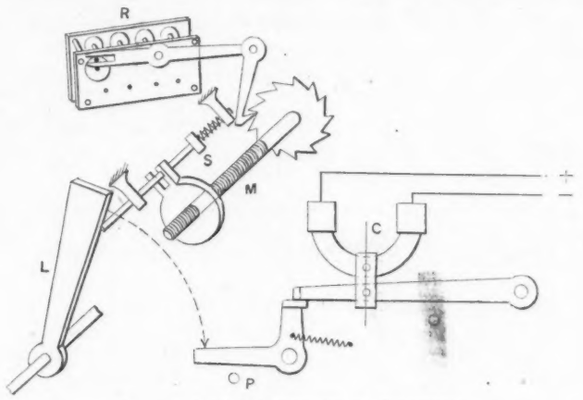


FIG. 3.—COIN-CONTROLLED MECHANISM.

stop is returned again by the action of some kind of mechanism M through the registering device R of the watt-hour meter, lever L will drop, strike the switch lever stop P and thus release the cut-out C.

When lever L is in its upward position, it will be seen that very little energy will be required to release it.

(4) In considering the fourth and last case, releasing the main switch indirectly and with electrical means, the accumulated energy of a spring or weight could be made useful in combination with an electrical relay, which latter could be operated by a small switch on the registering device of the meter, as shown in Fig. 2.

In the application of any of these four cases, the coin, which is placed in the meter, can be forced to be useful in many ways. The coin could close a small circuit either directly by its own metallic substance or indirectly by its own weight, falling on two spring contacts, for instance. It could also move a small mechanical device from the releasing point of the main cut-out (Fig. 2). The coin could be used to cause the consumer to wind up a spring or raise a weight by means of a lever or knob and at the same time close the main switch.

It would be decidedly convenient for the consumer if he should not be forced to do any operation whatever by placing a coin in the meter, but as there are so many disadvantages in regard to the absolute positive actions of the mechanism and also in regard to the tamper-proof condition of the meter, it seems almost certain that the future prepayment meter must have a device to be operated by the consumer when inserting a coin.

Any of the above-mentioned arrangements could be used for a switch for interrupting from 15 to 25 amperes at 120 volts. If a switch for a much heavier current should be desired, it would be advisable to shunt only a small current through the cut-out in the meter, which then again could be used to operate a main cut-out for any amount of current required. Several styles of automatic switches which would answer the purpose for this main switch are found on the market, and could easily be connected separately with the cut out of the prepayment meter.

Fig. 4 shows an automatic switch with plunger magnets in connection with a prepayment meter. A is the meter cut-out, for from .5 ampere to 1.0 ampere, which makes connection with contact plate E. As the current will pass through the solenoid S_1 of the main switch B, the plunger with knife-blade will fly up and make connection between M_1 and M_2, open the solenoid switch K_1 and remain in its position. As soon as the credited amount in the prepayment meter has reached zero, the knife-blade i of the meter-switch A will be released and will make contact at F, where solenoid S_2 is connected, which pulls down the plunger, opens the main circuit and cuts out the solenoid S_2 at K_2.

It will now be necessary to consider point (2) as mentioned at the beginning of this article. A device should show the consumer how much of the money he has placed in the meter is still to his credit. This device could be constructed in the form of a graduated scale, which might be either round or straight, and could be used in connection with that mechanical device which is moved back and forth at the releasing point of the main switch as shown at S in Figs. 2 and 3.

As the coin device, and therefore the scale or pointer, can be used only for a certain number of coins, the designer must consider that after this number of coins is placed in the meter, the operator might be able to damage it by inserting an extra coin and thus bringing the scale or pointer out of position, or breaking a part of the inside mechanism. To prevent damage, the coin-slot could be closed by a lever, moving relatively to the scale or pointer, or the superfluous coin could be lead into another channel and thrown out again.

The scale should be as large as possible, in order to be visible and readable from a distance. It should show the consumer how many coins he can still place into the meter and also indicate, within a short time, when the main circuit will be broken. A lamp or bell might be used in connection with the scale or pointer for informing the consumer that the switch will soon open the circuit.

As the price of energy differs at many central stations, it will be necessary to have an adjustable mechanism secured to the meter which can be set in such a way as to give more or less energy according to the value of the coin thrown in the meter. This mechanism should be so constructed that it is possible to get at it while the prepayment meter is at the consumer's premises, in order to save time and money, which otherwise would be required for sending a newly-set meter from the plant or factory, if the price should be changed. A graduated scale should be made for this mechanism, showing different prices per kw-hour, to enable the electrician or the

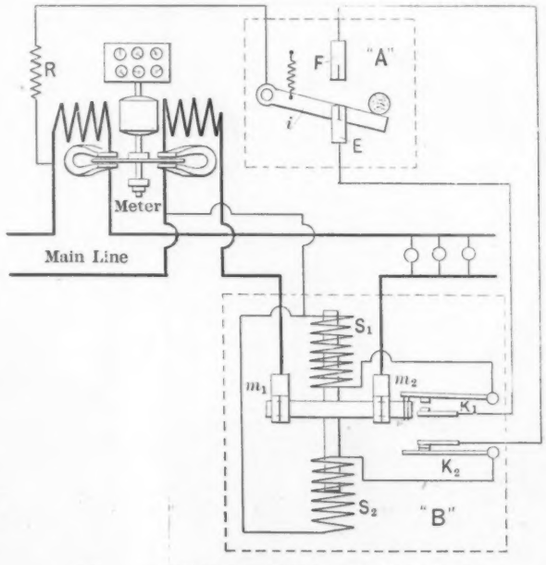


FIG. 4.—AUTOMATIC SWITCH ARRANGEMENT.

money collector easily to set the meter for the required amount.

In order to have the meter absolutely fool-proof and tamper-proof, the designer must consider every little point carefully. As the meter is generally located in a hall or cellar and seldom in a public place a certain class of people may therefore try to fasten the coin on a string and after the coin has done its work, will take it out again, or they may force a piece of wire through the slot in the meter, stop the working mechanism and thus cause the main switch to remain closed.

If the prepayment meter should be operated with a clock

spring, a consumer may keep the handle or knob in such a position that the spring energy which is designed to release the main cut-out may be taken off and thus prevent it from doing so.

One may take a strong magnet and stop the operation of the mechanism, or obtain access to the money box and so forth.

In regard to the construction itself, not much can be said, for it depends mostly on the ability and also originality of the designer himself, as there are many possibilities of tampering with the apparatus. It might be said, however, that as far as the coin is concerned, it has been found that when operated with a knob or lever, the coin ought to be out of sight and the slot closed during its operation.

If the consumer must operate as indicated above in order to work the meter, he may handle it rather roughly and, therefore, the question whether the watt-hour meter and the prepayment device should be combined in one or built separately as two different instruments should be carefully considered.

An important feature of separating the prepayment device and the meter lies in the advantages of being able to connect the prepayment device to any kind of meter, whether for direct or alternating current, or for high or low voltage.

A practical prepayment meter could consist of a device which is entirely separated from the meter and only connected with wires, leading from an electric relay in the prepayment mechanism to a contact on the registering device of the meter. It seems to the writer that the switch release of the prepayment device should be actuated by an additional source of energy to assure the positive actions of the mechanism.

Single-Phase Railway System.

At the December meeting of the A. I. E. E. two papers were presented dealing with the single-phase railway system. A paper by Mr. E. F. Alexanderson dealt with a new type of combined "repulsion" and series motor. An outline of the characteristics of this motor is given on page 143 of this issue. This motor was mentioned on page 1084 of our issue for Dec. 7, 1907. As intimated on page 8 of our Jan. 4 issue, this motor has been selected by the New York, New Haven & Hartford Railway Company for its New Canaan Division.

Mr. W. S. Murray presented a paper discussing the difficulties encountered and the successes obtained with the 11,000-volt overhead catenary single-phase system of the New Haven Company. A complete description of this system was given in our issue for Aug. 17, 1907. The single-phase equipment has been in use about six months, and much valuable experience has been obtained.

The author offered a number of observations and recommendations which will prove of value to engineers interested in the substitution of electric for steam locomotives.

1. In one, two, three, and four-track railroads, the distributing circuits should include by-passes or feeders, in addition to the trolley wires.

2. The electrical sections should average not less than 1.5 miles in length.

3. Twenty-two feet is a safe general working distance of the trolley from the rail.

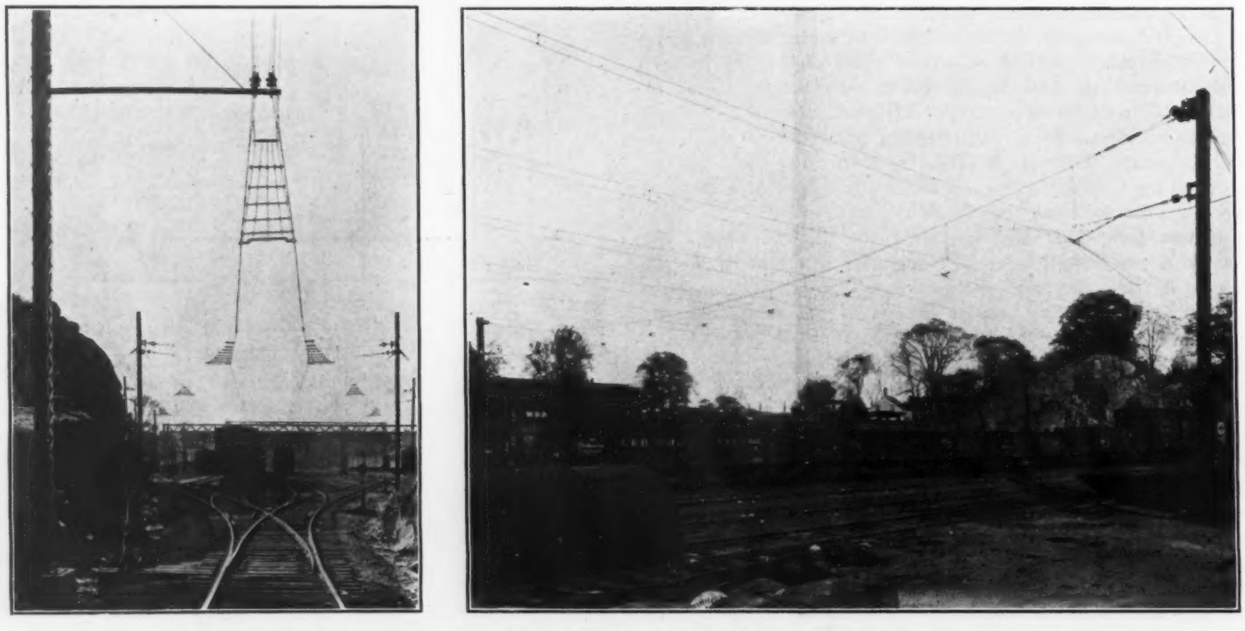
4. The de-insulating effect of steam locomotives stack discharges is a most important consideration to be kept in mind in insulating the high-tension wires from ground.

5. High insulation factors should be used where high-tension construction due to low bridges is brought nearer the rails than the normal height of 22 ft. Strong mechanical shields should be used to deflect the locomotive blasts from the messenger insulators at low bridges. Care should be exercised in the installation of these shields so that a safe distance exists between the high-tension conductors and the ground. Wherever possible insulators should be installed away from the direct line of the locomotive blast.

6. If the auxiliary wires cannot be carried over highway bridges as aerial conductors, they should not be carried under, unless they are enclosed in lead-covered cables with end-bells properly enclosed in suitable housings at points where the conductors change from aerial to lead-covered cables.

7. All circuit-breakers connecting feed wires (or by-passes) to the trolley bus-bars should be equipped with time-relays, so that any short-circuit will immediately open the trolley-breakers, thus locating the grounded trolley section. Equipping the feeder breakers with time-relays insures continuity of voltage on wires not affected by the short-circuit. Each trolley-breaker pilot-switch should be provided with a lamp to indicate when it opens, and an announcer bell should ring in the signal tower at the same time so that the operator is promptly notified.

8. On account of deleterious influences of the weather and of locomotive stack discharges, together with the general inconvenience of getting at bus-bars and switches when installed on anchor bridges, all section oil-switches should be installed in switch houses erected at the side of the tracks, with lead-covered cable connections between the trolley and the switches.



FIGS. 1 AND 2.—FLEXIBLE SINGLE CATENARY SUSPENSION IN THE PORT CHESTER YARD.

9. The signaling apparatus should be arranged so that the operator can prevent the engineer from spanning two sections by his locomotive shoes in the event of one section being grounded.

10. All signal towers should be interconnected with a reliable telephone service. Immunity from electromagnetic and electrostatic disturbance in the telephone system can be secured by using twised-wire pairs enclosed in lead-covered sheath, the sheath being grounded frequently.

The last suggestion is more particularly applicable to the interrupted or tower-to-tower telephone system. In this case the distance of exposures of the telephone wires is not great, and thus the summated effect of electromagnetic induction is negligible. In the case of the through telephone line where the circuit is uninterrupted throughout the zone of electrification, again the lead sheath and twisted pair are respectively effective in removing all static charges, and electromagnetically balancing the circuit; but on account of the cumulative action of the electromagnetic induction, either compensating transformers or a system of impedance coils installed across the telephone circuits at intervals of 2 miles (this distance may be less, depending on the electromagnetic destiny) with their central points grounded should be used. Either method will satisfactorily remove the impressed voltage due to electromagnetic induction. The importance of reliable telephone service between operating towers cannot be too greatly emphasized.

In regard to sectionalization it is noteworthy that it is impossible to elect some standard distance and then apply it to an old steam road. Even in the extreme case of an entirely new electric line it would be a strange coincidence to find, for example, 50 towns just two miles apart along the right of way. It is necessary to consider the individual lengths in accordance with the local condition, but the total number used over a certain length of road can largely be specified with considerable freedom.

The anchor insulators, which have given the best results from a combined mechanical and electrical stress point of view, have been of corrugated cylindrical form. In this form their insulating value is unquestionably less than the mushroom or petticoat type of insulator, and experience indicates that they are very much less reliable than the mushroom or petticoat type (this form of insulator is used to support the messenger cables on intermediate catenary bridges). It is believed, however, that by suspending some form of protective shield or petticoat from the anchor insulator, its insulating value will be greatly enhanced. The blast from steam locomotives seems to produce a very rough enamel of coal dust and cinders, which, on account of deeply imbedding itself in the insulator, is almost impossible to remove, in consequence of which insulating values are greatly reduced.

None of the difficulties encountered with the system has been of a character which could be interpreted as a menace to the general principles involved. The difficulties have either been corrected, or their correction is easily in sight.

At the conclusion of the reading of his paper, Mr. Murray stated that the discussion of the relative advantages of double and single cantenary constructions had been omitted intentionally. A choice of the one or the other must be a compromise of a great many considerations, the principal one being the number of tracks and the local conditions, but there is one fact that has been conclusively demonstrated, namely, either the trolley wire or the trolley shoe must be flexible whether the construction be for main or branch lines. In the single catenary construction a flexible contact conductor is provided. In the triangular construction the contact conductor is rigid. This requires a flexible shoe, which in a degree is secured by the spring pantagraph arrangement. Experience, however, has shown that the pantagraph should be still further supplemented by a light, but strong mechanism, which will insure flexible contact between the shoe and the trolley wire, thus not offering a great deal of inertia in movement when the shoe meets the hard spots of the line, which exists at the catenary hanger points.

A form of construction adopted in the East Port Chester yard, in which the latitudinal catenaries are supported by cross catenaries (in some cases spanning as many as ten tracks) contains a great many attractive features, and experience may indicate the desirability of using the cross catenary for main line work. Such an arrangement, if more frequently reinforced with cross-bridge anchorages, such as are now used in the New Haven system, will afford a lighter and cheaper construction, and possibly give a greater opportunity in insulating the overhead system from ground. There seems to be no reason why single catenary spans should be made any less in length than those used in the double catenary construction, as the cross-rigidity that may be desired, can be obtained by tying together adjacent latitudinal catenaries all of which are subject to the pull off construction at present employed.

(The flexible suspension in the Port Chester yards, described by Mr. Murray in the above paragraph, is illustrated herewith.—EDITORS.)

DISCUSSION.

Mr. L. B. Stillwell expressed his sincere appreciation of the attitude of the New Haven road and its engineers in frankly disclosing not only the successes but the difficulties. He stated that the strong point of the Alexanderson motor is its ability to commutate under speed without sparking. However, at the moment of starting the sparking may be serious. The facts given concerning the new motor seem to show that it will gain as much in the ratio of output to weight by a reduction of the frequency from 25 to 15 cycles as will the compensated series motor.

A communication from Mr. B. G. Lamme was read by F. H. Shepard. Mr. Lamme showed that in order to limit the sparking at starting in the Alexanderson repulsion motor it is necessary to reduce the field strength considerably below the value allowable when resistance leads are used with a compensated-series motor. Even if the field strength were reduced to 70 per cent of normal the short-circuit current would have five times the normal value and the working current for double-torque would have to be 2.86 times the normal. With preventive resistance leads the short-circuit current would be 1.25 times normal and the working current for double-torque only 1.6 times normal. Thus the brushes of the former motor would have to carry three times as much current at starting as those of the latter. With the same limiting short-circuit voltage, the flux could be increased by 66 per cent by using 15 instead of 25 cycles, and the output could be increased by about 30 per cent.

Mr. W. B. Potter expressed the opinion that overhead wires subject to lightning should not be run through lead cables. Since auxiliary wires can be so located as to be less exposed to the locomotive exhaust than can the contact-trolley wire, there is little need of supporting them on insulators underneath a bridge, and it is better to omit the lead covering suggested by Mr. Murray. The only safeguard against spanning two trolley sections in the event of one of them being grounded is to place a fuse between the two collectors. The essence of the improvement embodied in the Alexanderson motor is the better inherent commutation. By reason of this improvement it is possible to modify other features affecting the performance of the motors which have heretofore been subordinated to commutation, with an accompanying greater reliability, lessened maintenance cost and increased output for a certain amount of active material.

Mr. O. S. Lyford, Jr., remarked that in sectionalizing a trolley system other things must be taken into account besides the trouble on the line. On a railroad provided with a positive block system, the process of getting the rules abandoned so that a special train can proceed against the block is about as difficult as making the repair after reaching the trouble. It is essential to insulate the high-voltage trolley system thoroughly, which at the present state of the art dictates the exclusive use of porcelain.

Mr. W. I. Slichter explained that in the Alexanderson motor

certain features are introduced to assist in starting, and others are employed only when running. The compensating and inducing winding is provided with twice the number of turns as are on the armature. Hence when the armature is short circuited at starting there is twice as much current in the armature as in the field coils, while under running conditions the current in the field coils is equal to that in the armature. Thus the field flux is relatively smaller at starting than while running. The tendency to sparking, which is minimized at starting, is neutralized under running conditions. A certain amount of wattless volt-amperes is required for maintaining the commutating field, but the improvement in commutation increases the efficiency and lessens the maintenance cost.

Dr. C. P. Steinmetz stated that the two great objections to alternating-current commutotor motors for railway work have been the impracticable low power factor and the hopelessly bad commutation. About 18 years ago Mr. Eickemeyer produced the compensating winding which allows a motor to be constructed with a reasonably good power factor. The second serious problem of the motor relating to commutation has been eliminated in the Alexanderson motor, and the alternating-current commutator motor may now be considered in practically as good a shape as the direct-current motor. It may be stated, therefore, that the period of youth of the alternating-current railway motor is concluded.

Solenoid in Series with Resistance.

By Charles R. Underhill.

THERE are many cases in practice where a solenoid is operated in a circuit containing a resistance in series with, and external to, the resistance of the winding itself. Theoretically there will always be some external resistance, as, for instance, the resistance of the leads to the solenoid and other wiring; but since the resistance of windings for local use, and particularly if designed to remain in circuit indefinitely without overheating, is great as compared with the resistance of the wiring and source of energy, this external resistance is not usually considered.

However, in this article the resistance in the circuit external to the resistance of the winding will be taken into consideration. The old rule "Make the internal and external resistances equal," holds for the maximum electrical power in watts which may be obtained in a winding, and also for the maximum magnetizing force for the winding under certain conditions; but this rule is not strictly correct as applied to the conditions in actual practice.

If we let E = voltage of source of energy,
E_1 = voltage across winding,
R = resistance of winding,
and R_1 = all other resistance in the circuit,
then $E_1 = \frac{RE}{R+R_1}$ (1).

Fig. 1 shows the percentage of maximum values for volts and watts for the winding according to this rule, the watts being maximum when $R = R_1$, and $E_1 = \frac{E}{2}$.

It is well known that the ampere-turns in a winding are constant when the size of wire, diameter of average turn (M), and voltage across the terminals of the winding, are constant, and regardless of the number of turns and consequently the space occupied by the insulating material on the wire. This relation may be expressed: $In = \frac{E_1}{\pi \rho M}$ (2), in which ρ is the resistance per unit length of wire. In English measure, with the inch as the unit, $\rho = \frac{8.6284}{10^7 d^2}$ (3) at 68 deg. F., where d represents the diameter of the wire. (2) may therefore be written: $In = \frac{10^7 E_1 d^2}{27.107\, M}$ (4).

In the American wire gage (B. & S.) the cross-sectional area of the wires varies nearly in the ratio of 10 for every ten sizes, the real ratio being 10.164:1. On this basis Fig. 2 has been plotted, the values for wires from No. 20 to No. 30 being correct; but for wires from No. 10 to No. 20 and between No. 30 and No. 40 the values are correct within 1.64 per cent, which is near enough in practice, owing to the gaps between consecutive sizes of wires.

The ampere-turns may be quickly found by this method in the following manner: First find the ratio Θf by dividing the voltage across the winding by the diameter of the average turn (M), or $\Theta f = \frac{E_1}{M}$ (5). Then by comparing the value $\Theta = \frac{E_1}{fM}$ (6) with the desired ampere-turns, the proper size of wire (B. & S.) will be found under the value of f, which value will be either 10, 10^2 or 10^3 for the sizes indicated in

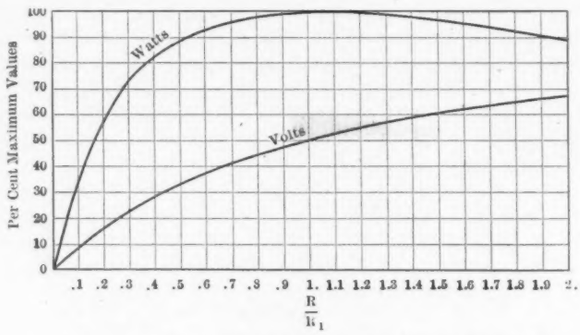


FIG. 1.—CHARACTERISTICS OF TWO RESISTANCES IN SERIES.

Fig. 2. It is well to note here that when $f = 10$, the values are for wires from No. 10 to No. 20, and when $f = 10^2$ the values are for wires from No. 20 to No. 30, etc. When the value of $\Theta = \frac{E_1}{fM}$ exceeds the values of the points of intersection on the chart, divide this value by 10, and multiply the corresponding value of ampere-turns by 10, or multiply the value of f by 10, according to whether the size of wire or the ampere-turns, is fixed.

While the ampere-turns in a winding are absolutely independent of the number of turns in the winding, under the conditions mentioned above (voltage constant), the economy of operation varies directly with the resistance of the winding. Therefore the greater the resistance of a winding of fixed

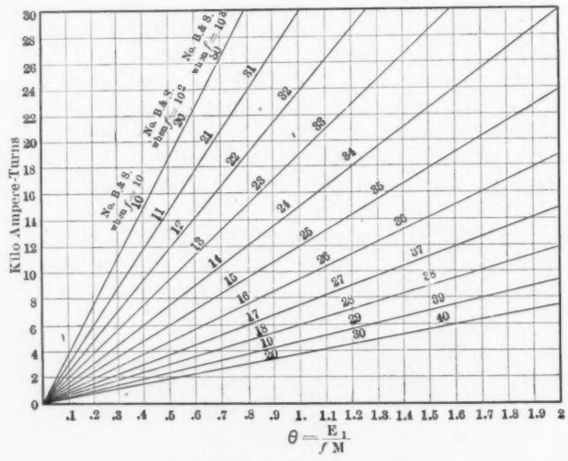


FIG. 2.—AMPERE-TURN CHART.

dimensions, voltage and size of wire, the greater will be the amount of copper contained in the winding, and the greater will be the economy.

For a winding in the form of a hollow cylinder,
where M = diameter of average turn,
L = length of winding,
and T = thickness of wall of winding,
the resistance may be expressed:

$$R = \frac{27.107\, MLT}{10^7 d^2 d_1^2} \quad (7)$$

in which d_1 is the diameter over the insulation on the wire.

The watts in the winding will then be $W = \frac{10^7 E_1^2 d^2 d_1^2}{27.107\, MLT}$ (8), and since by (4), $In = \frac{10^7 E_1 d^2}{27.107\, M}$, $W = \frac{In E_1 d_1^2}{TL}$ (9), and $In = \frac{WTL}{E_1 d_1^2}$ (10). The relations in (9) and (10) will be clear since $n = \frac{TL}{d_1^2}$ (11). Therefore the watts may be calculated from the ampere-turns when the other constants are known, and vice versa.

The coefficient of space utilization, when round wire is considered, is $c = \frac{d^2}{d_1^2}$ (12), and hence to determine the economy factor (h) of a winding, the watts should be multiplied by c. Therefore $h = Wc$ (13) or $h = \frac{Wd^2}{d_1^2}$ (14).

Now consider a magnet winding of fixed dimensions in series with an external resistance, equal to that of the magnet winding, and a source of energy of constant voltage. When $\frac{d^2}{d_1^2} = 1$, which would be the ideal case for round wire, the ampere-turns will attain their maximum value for that size of wire, but if, as in the case of a No. 30 wire insulated with 4 mil increase double silk, $\left(\frac{d^2}{d_1^2} = .51\right)$, it would be necessary to use a wire of approximately twice the resistance per unit length in order to keep the resistance of the magnet winding

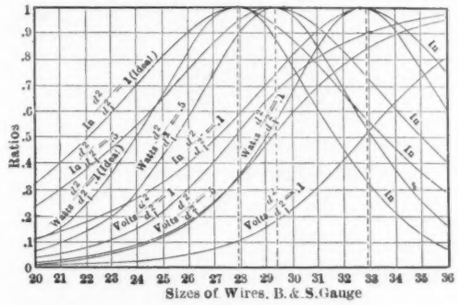


FIG. 3.—EFFECT WITH VARIABLE THICKNESS OF INSULATION, $\frac{d^2}{g^2}$ CONSTANT.

the same in the latter case as in the former, and hence when the watts in the magnet winding were maximum, the ampere-turns would be approximately 50 per cent of their maximum value for ampere-turns in the ideal case.

However, there are two distinct effects to be considered: (a) in which case the space occupied by the insulation on the wire bears a constant relation to the space occupied by the wire throughout the various sizes of wire, as for instance, when $\frac{d^2}{d_1^2} = .5$ for all sizes of wire, and (b), in which the thickness of insulating material on the wire is constant for all the various sizes of wire. In the former case (a) it would be necessary to use a different thickness of insulating material for each size of wire, in order to keep $\frac{d^2}{d_1^2}$ constant, and hence case (b) is the method adopted in practice. In this latter case the value of $\frac{d^2}{d_1^2}$ changes with every change in the size of the wire.

By assuming $E = 100$ and $R_1 = 100$, the relations in Figs. 3 to 5 have been calculated. Under these conditions the maximum value for the watts in the winding will be 25, when $E_1 = 50$ and $R = 100$. Fig. 3 shows the relations for several values of $\frac{d^2}{d_1^2}$ under case (a) in which these values are constant. It will be noted that the ampere-turns and watts are maximum simultaneously for each respective value of $\frac{d^2}{d_1^2}$, and that this point is determined by the intersection of the volts curve with the ordinate .5. While the maximum value for watts is 25 for any size of wire, under these conditions, the ampere-turns vary in the ratio shown in Fig. 4.

In Figs. 3 and 4 the relations expressed by the rule first referred to hold true, but in Fig. 5, where the values of $\frac{d^2}{d_1^2}$ are variable (case b) the watts and ampere-turns are not maximum simultaneously, although the point of maximum watts is determined by the intersection of the volts curve with the ordinate .5 as in case (a), Fig. 3.

The point for maximum ampere-turns with $\frac{d^2}{d_1^2}$ variable (Fig. 5) is determined by the intersection of the insulation

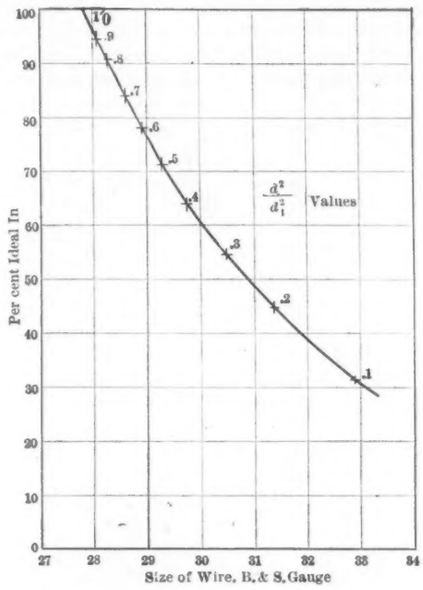


FIG. 4.—EFFECT OF INSTALLATION.

curve with the ampere turns curve for that insulation. This gives the value of $\frac{d^2}{d_1^2}$ which will show the percentage of ideal ampere-turns, as in Fig. 4. This curve is reproduced in Fig. 5 (marked e) and its origin is at the intersection of the ideal volts curve and the ordinate .5, which ordinate represents the maximum value for the percentage of ideal IN (curve e).

The size of wire which will give the maximum ampere-turns under these conditions, and with a given thickness of insulation, is determined by the intersection of the volts curve for the given insulation with curve e. Having once plotted curve e it is an easy matter to find the size of wire to give the maximum

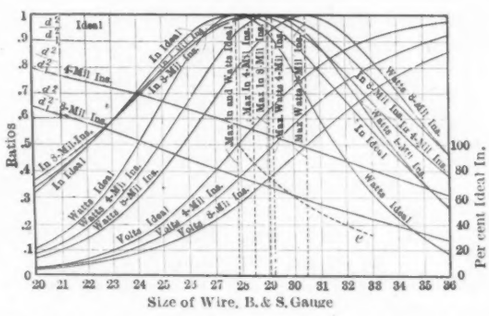


FIG. 5.—EFFECT WITH CONSTANT THICKNESS OF INSTALLATION, $\frac{d^2}{g^2}$ VARIABLE.

ampere-turns for any case, by first calculating the size of wire (assuming the insulation to be nil) which will produce the maximum ampere-turns for the ideal case $\left(\frac{d^2}{d_1^2} = 1\right)$. Two points for volts may then be calculated, taking into consideration the insulation on the wire. One of these points should be taken on the ordinate .5, i. e., when $R = R_1$ (and hence $E_1 = \frac{E}{2}$) calculating the size of wire. The other point should

be taken for voltage on the abscissa representing the size of wire to produce ideal ampere-turns, referred to before. Connecting these points will locate the size of wire on curve *e* which will produce the maximum ampere-turns with the given insulation as previously explained.

Fig. 6 shows this principle, in which curve *e* is plotted to the same scale as in Fig. 5. In this case, however, the curve is a straight line at an angle of 50 deg. with the ordinate .5.

As an example, assume a solenoid with an available winding volume of 20 cubic inches, and with an average diameter of 2 ins., to be operated on a 220-volt circuit in series with a resistance of 200 ohms. Assuming $d^2 = d_1^2$, and by rearranging (7), the diameter of the wire (d) is found to be .017 in., or between No. 25 and No. 26 (approximately No. 25.4) B. & S. By (2), or referring to Fig. 2, the ampere-turns are found to

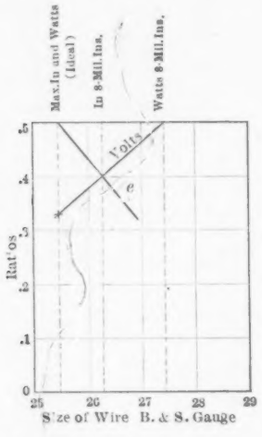


FIG. 6.—CURVE "E" AS STRAIGHT LINE.

be approximately 5850. Now when $E = E_1$, $R = R_1$, and hence the resistance of the solenoid, when watts are maximum, will be 200 ohms. Assuming 8 mil insulation, and calculating d from (7), the diameter of the wire is found to be .0136 in. or between Nos. 27 and 28, or by the formula $S = \frac{\overline{1}.662758 - \log d}{.0503535} - 3$ (15) in which S is the size of wire, B. & S. gauge, the fractional size is very nearly No. 27.5.

The point where the voltage curve intersects the ideal abscissa is calculated from the same size of wire as in the ideal case, i. e., No. 25.4 or .017 in. diameter, but with the 8 mil insulation. By (7) the resistance is found to be 95.5 ohms, and by (1) the voltage (E_1) is 71, or 32.2 per cent of 220 volts. Therefore the size of wire with 8 mil insulation, which will produce the maximum ampere-turns under these conditions is approximately No. 26¼.

As a practical proposition the size of wire may be calculated for a 50-per cent drop in volts across the winding, using the next larger size of wire, unless the value of $\frac{d^2}{d_1^2}$ is near unity.

The Slide Rule in the Calculation of Magnetic Reactance.

By M. S. Howard.

Although several articles have appeared in the electrical journals in recent years setting forth the relations between the logarithmic scale of the slide rule and the wire table, and giving methods for obtaining the weight, resistance, diameter, etc., of wires, and for calculating the sizes of wire required for a certain distance, load and loss with the slide rule alone without the use of tables, the writer has never seen in print the following simple and expeditious method for calculating the reactance of alternating current circuits by means of the slide rule.* It is therefore offered in the hope that it may prove of some value, as it makes possible the determination of the characteristics of a circuit or transmission line with great rapidity and sufficient accuracy in ordinary cases, without reference to tables of any kind or the tedious solution of formulæ.

The general formula for the inductance of a single wire of raduis r situated at distance D from the return wire is, in henrys

$$L = l\,(2\log_e \frac{D}{r} + \tfrac{1}{2})\ 10^{-9}$$

in which l is the length in centimetres. For $l = 1000$ feet and in terms of common logarithms the expression becomes, in henrys

$$L = \frac{1404.}{10^7}\,(\log \frac{D}{r} + .1086)$$

Reactance $x = 2\pi fL$, hence for a frequency $f = 60$ cycles per second

$$x = \frac{2 \times 3.1416 \times 60 \times 1404}{10^7}\,(\log \frac{D}{r} + .1086) \text{ in ohms}$$

$$= .053\ (\log \frac{D}{r} + .1086) \text{ in ohms.}$$

If d is the diameter of the wire, equal to $2r$, the formula may be put into the form

$$x = .053\ (\log \frac{D}{10d} + 1.4096) \text{ in ohms}$$

which reduces to

$$x = .106 \times \tfrac{1}{2} \log \frac{D}{10d} + .0747 \text{ ohms}$$

$$= .106 \log \sqrt{\frac{D}{10d}} + .0747 \text{ ohms} \qquad (a)$$

or approximately

$$x = \frac{1}{10} \log \sqrt{\frac{D}{10d}} + .0765 \text{ ohms.} \qquad (b)$$

The constant term is made .0765 in equation (b) instead of .0747 to distribute the error introduced by using the coefficient $\frac{1}{10}$ instead of .106 for the first term. In this form the formula admits of a very simple solution on the slide rule, and the maximum error for extreme values of the ratio $\frac{D}{10d}$ will seldom exceed two per cent and for ordinary working values of this ratio the accuracy is within one per cent. If greater accuracy is desired, however, use may be made of equation (a), which will give the same degree of accuracy as can be obtained with the slide rule in the solution of any other problem.

To avoid the necessity of remembering the constant term it should be marked on the zero end of the logarithm (L) scale.

To get the reactance for any other frequency multiply the result as obtained for 60 cycles by $\frac{f}{60}$, f being the given frequency.

For example let it be required to find the reactance per 1000

*Since the present article was prepared, the writer's attention was directed to an article by Mr. T. W. Varley appearing in the Electrical World of Feb. 9, 1907, wherein there is described a graphical method for determining reactances by employing a logarithmic diagram. While the process of calculating reactances is rendered quite simple by the use of this diagram, it is probably no more convenient than the usual reactance tables and no more likely to be at hand when needed. Moreover, the use of tables is not entirely eliminated as the scheme includes a table of values of the ratio $\frac{D}{10d}$ to be used with the diagram. The slide rule, however, is a standard device usually found in the office and drafting room, can be conveniently carried in the pocket when in the field, is not limited to the one operation, and, with the exception of the one addition, the entire solution of the problem is possible with it.

ft. of wire at a frequency of 25 cycles per second of a circuit of No. 2 B. & S. gauge wire spaced 30 ins. between centers.

Then $D = 30$ and, as the diameter of No. 2 B. & S. gauge wire is .257 in., $10d = 2.57$. Set 2.57 on the B scale beneath 30 on the A scale, turn the rule over and read .534 on the logarithm (L) scale on the back of the slide opposite the right hand index. Then for a frequency of 60 cycles per second, if equation (b) is used, the reactance per 1000 ft. of wire would be

$$x = \frac{.534}{10} + .0765 = .1299 \text{ ohms},$$

or using equation (a)

$$x = .106 \times .534 + .0747 = .1313 \text{ ohms}$$

and for 25 cycles per second

$$x = .1313 \times \frac{25}{60} = .0547 \text{ ohms}.$$

The explanation of the first operation is obvious, since $10d$ on the B scale having been set beneath D on the A scale, the quotient $\frac{D}{10d}$ would be read on the A scale opposite the left hand end of the B scale, and the square root of this quotient $\left(\sqrt{\frac{D}{10d}}\right)$ would be obtained on the D scale directly beneath and opposite the left hand index of the C scale; therefore, the reading on the logarithm (L) scale, which is the logarithm of the number on the D scale opposite the index of the C scale,

$$\text{is log } \sqrt{\frac{D}{10d}}.$$

If 10 times the diameter of the wire ($10d$) is greater than the distance between the centers of wires (D), the slide will project to the left when $10d$ on the B scale is set beneath D on the A scale, which indicates that the characteristic of log $\sqrt{\frac{D}{10d}}$ is -1, because $\sqrt{\frac{D}{10d}}$ is less than 1. By advancing the slide by the full length of the scale to the right, the mantissa of the logarithm may be read on the L scale as before. As an illustration, if, in the example given above, the distance between wires had been 2 ins. then, on setting 2.57 on the B scale beneath 2 on the A scale, the slide projects to the left. When the slide is advanced the full length of the scale to the right the mantissa is found to be .945 and, since the characteristic is -1,

$$\log \sqrt{\frac{D}{10d}} = -\bar{1}.945$$
$$= -.0055$$

and

$$x = .106 \times -.0055 + .0747 \text{ ohms}$$
$$= .0689 \text{ ohms}.$$

For sizes smaller than No. 10, $10d$ is fractional, and it is necessary to multiply by 100 to bring it within the range of the rule; in order not to effect the final result, the same factor must be introduced into the numerator. The expression then becomes

$$x = .106 \log \sqrt{\frac{100\,D}{100 \times 10d}} + .0747 \text{ ohms}$$

$$= .106 \left(\log 10 + \log \sqrt{\frac{D}{1000d}} \right) + .0747 \text{ ohms}$$

$$= .106 \left(1 + \log \sqrt{\frac{D}{1000d}} \right) + .0747 \text{ ohms}.$$

That is, when $10d$ is less than unity, multiply it by 100 and add 1 to the logarithm as then found.

For example, find the reactance per 1000 ft. of wire at a frequency of 60 cycles per second of No. 14 B. & S. gauge wire spaced 10 ins. between centers. As the diameter of No. 14 wire is .0648, $10d = .648$ and $100 \times 10d = 64.8$. When 64.8 on the B scale is set beneath 10 on the A scale the slide projects to the left, which shows that the characteristic of the logarithm is -1. Advancing the slide by the length of the scale to the right, the mantissa read on the L scale is .594 and

$$x = (1 + -1.594) + .0747 \text{ ohms}$$
$$= .106 \times .594 + .0747 \text{ ohms}$$
$$= .1377 \text{ ohms}.$$

Likewise if the distance D between centers of wires exceeds 100 ins. divide it by 100 and then add 1. to the logarithm as found.

As the diameter of the wire may also be obtained directly from the slide rule when the B. & S. gauge number is given, the entire operation for determining reactance may be performed without reference to tables. Methods for obtaining the diameter have been given by Mr. Carl P. Nachod (ELECTRICAL WORLD March 3, 1907, and Sept. 7, 1907), and by Mr. Otto E. Falch, Jr. (ELECTRICAL WORLD, Aug. 3, 1907). Another convenient way is as follows: Set the number representing the size of the wire on the L scale opposite the index on the back of the rule, and place the runner at 10400 (approximately the circular mils in a No. 10 wire) on the D scale, then the number of circular mils in the chosen wire may be read under the runner on the C scale and the square root of this is the diameter sought. If a slide rule is at hand, therefore, neither resistance nor reactance tables of wires are essential to the calculation of circuits or transmission lines, since it is possible to determine by means of the slide rule alone the size of wire required for certain conditions of distance, load and loss by using the formula given by the author (ELECTRICAL WORLD, Dec. 30, 1905), and with the same device, the size having been determined, to calculate the reactance by the method given in this article and the resistance by methods described in Mr. Carl P. Nachod's articles. Moreover all these processes are devoid of complication and give quite accurate results.

Dynamometer for Testing Automobiles.

An important advance has been made in the manufacture and sport of the automobile in the construction, by the Automobile Club of America, New York, of a dynamometer which will determine instantly the speed in miles per hour and feet per second, draw-bar pull or tractive effort, horse-power, grade climbing ability, and power of the brakes of any automobile which is placed upon it.

The dynamometer, besides being the most complete apparatus ever built for testing automobiles, makes it unnecessary to get special permission to speed machines in making a running test, will eliminate all danger of road accidents during tests, and give the results more quickly and accurately than in any other way.

The dynamometer is a moving track upon which cars can be fully tried out while remaining stationary and under observation. In 1904, Dr. Schuyler Skaats Wheeler was requested by the club to invent, design and build a machine for determining accurately the performance of cars of all kinds. The present machine is, therefore, the result of several years' attention to this problem on the part of Dr. Wheeler.

It is an assemblage of power absorbing and measuring instruments, and a large power chart with automatically operated pointers. It carries the problem of power measurements, integration and automatic recording of the final results, much farther than has hitherto been attempted. It absorbs and measures the power so that, at a glance, the speed, tractive effort and horse-power can be clearly seen and read at each instant. The measurements show the power delivered at the ground by the wheels of the automobile. This includes every element in the operation of the automobile, and, therefore, shows the net power that is available for driving the car.

Instead of traveling along, as on a road, the car is held sta-

tionary by cables upon the floor with its driving wheels resting upon two large drums which reach up through the floor, and which the engine of the automobile causes to revolve. The revolution of the drums is resisted by a huge pendulum hanging below the floor, and attached to the drum shaft, not rigidly, but through a device furnishing a degree of friction which can be varied.

The pendulum, in consequence, swings out from the vertical a distance exactly proportional to the pull exerted by the car upon the drums. The amount of this pull, or tractive effort, is indicated by a pointer attached to the pendulum and reaching

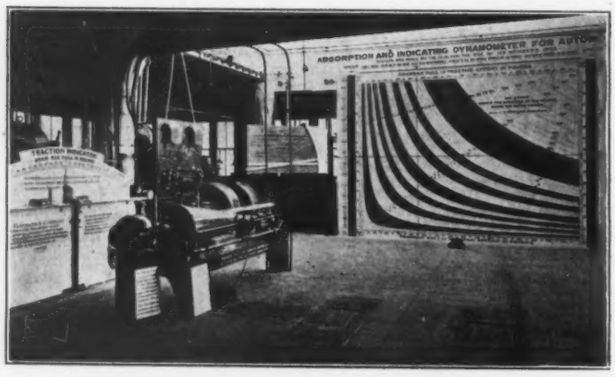


FIG. 1.—DYNAMOMETER FOR AUTOMOBILES.

above the floor. This weighing apparatus or pendulum has been tested and certified correct by the Fairbanks Company. The indications given by the pendulum are transferred to a ruler traveling across the face of a large chart by a wire cable moved by a small motor, in such manner that with each varying position of the pendulum pointer, the cable is moved to correspond to its new position.

The more difficult operation of measuring accurately the speed of the car, by moving another ruler vertically across the large chart, is accomplished by special apparatus of some novelty.

A cone is revolved by an electric motor at absolutely constant speed. To verify this speed, a bell, attached to the cone shaft, rings at each 100 revolutions, or at intervals of 30 seconds. A wheel or roller, driven by the automobile and, therefore, revolving slowly or fast to correspond, rolls upon the surface of the cone and is pulled, by an independent motor, back and forth between the small and large ends of the cone until it finds the point where it does not slip because that portion of the cone presents the same speed as the roller. This longitudinal adjust-

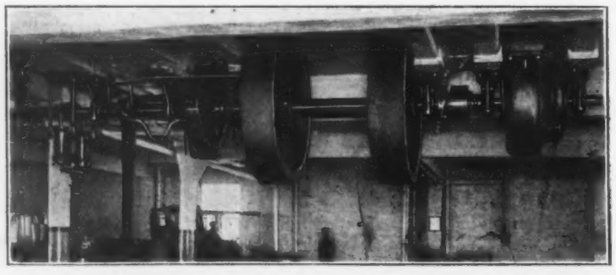


FIG. 2.—PORTIONS OF DYNAMOMETER BELOW TESTING FLOOR.

ment of the roller is transmitted by a wire cable to the speed ruler on the chart, and the power required for moving the ruler is thus made independent of the automobile. In other words, none of the power of the automobile is used in operating the indicators on the chart. The method of speed measurement employed, based upon one element running at a constant speed like a clock, that can be verified, insures great accuracy. The roller, driven by the car if running at 60 miles per hour, must be drawn to a position near the large end of the cone in order to run with the cone. Whereas, if the car drives the roller at only five miles per hour, it must be drawn to a position near the small end of the cone. A system of electric contacts is arranged with a motor to shift the roller automatically until it finds the point where it will roll on the cone without slipping.

The speed and power rulers are thus moved across the chart automatically to correspond with the speed and the tractive effort or pull that the dynamometer shows the car is making.

On the board are painted the horse-power corresponding to each different speed and pull so that the result at each moment can be read at a glance and without calculations.

The chart is in heroic scale and can be read easily by the driver of the car. The speed of the car may be read from the chart in either of the popular ways of stating it; miles per hour, minutes per mile, kilometers, etc., by means of the several different scales provided.

All of the measuring apparatus is made reversible so that when running backward the performance of the car may be measured.

As a secondary apparatus, a grade meter is provided, operated by the pendulum indicator of the dynamometer. To use the grade meter the clamp is set upon the sliding scale at the point representing the weight of the car. The moving lever then assumes at each moment the angle of inclination of the grade the car would climb (if there were no wind resistance, slipping, etc.), with the effort that the car is then making.

To observe an automobile coasting down hill, either forward or backward, it is necessary merely to start the electric motor on the shaft carrying the two large drums upon which the driving wheels of the automobile rest. The brakes may then be tested, and the wheels or gears or engine may be run free (not run by the power of the automobile) and the relative friction loss of the automobile may be ascertained. The exhaust from the automobile engine is directed into a pipe connected to an electrically driven exhaust fan so that the test room is free from smoke and obnoxious fumes. The apparatus was built by the Crocker-Wheeler Company.

Single-Phase Railway Motor.

At the meeting of the A. I. E. E., held on Jan. 10, Mr. E. F. Alexanderson presented a paper devoted to a technical description of a single-phase commutator motor that possesses advantageous characteristics for railway work. The machine is called a "series-repulsion" motor, because it embodies many of the best features of the so-called plain repulsion motor and of the compensated series motor.

In mechanical construction the machine differs immaterially from either a (Thomson-Atkinson) repulsion motor or a con-

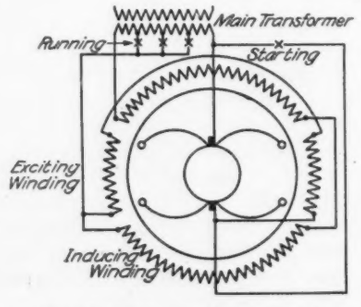


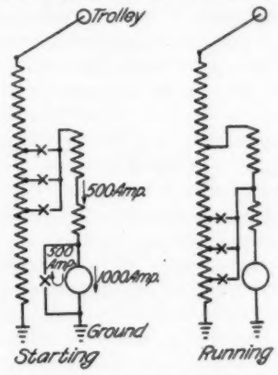
FIG. 1.—ARRANGEMENT OF MAGNETIZING CIRCUITS.

ductively compensated motor. However, the "compensating" winding, termed the "inducing" winding, has twice as many turns as would usually be employed for a series motor. The mechanical arrangements of the circuits are indicated in Fig. 1.

The electrical connections of the rotor and stator circuits during the starting and the running periods are shown in Figs. 2 and 3, respectively. The magnetizing actions of the stator windings are not indicated in the last two illustrations, but they can be ascertained by studying these two diagrams in connection with Fig. 1. It is believed that the characteristics of the motor under starting and running conditions can most readily be shown by the use of Figs. 4, 5, 6 and 7.

The connections of Fig. 4 are electrically equivalent in all

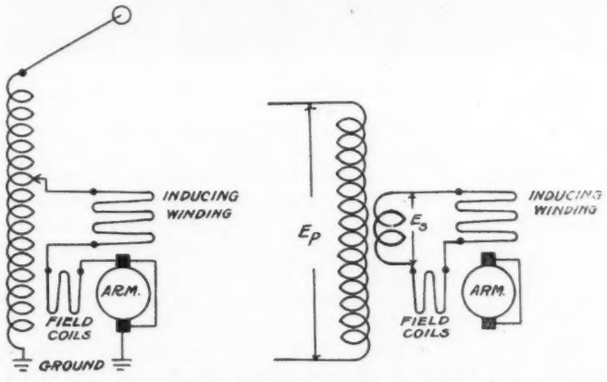
respects to those of Fig. 2, while the magnetic relations are also properly shown. Fig. 5 shows circuits whose electrical characteristics and magnetic behavior are the same in every respect to those in the circuits of Fig. 4 or Fig. 2. It will be noted that the motor indicated in Fig. 5 is a so-called plain (Thomson-Atkinson) repulsion motor, and possesses all of the



FIGS. 2 AND 3.—ELECTRICAL CONNECTIONS IN STARTING AND RUNNING POSITIONS.

characteristics of this machine. The "inducing" winding has twice as many effective turns as the armature, hence the armature current at starting is equal to twice the current in the inducing coil, or to twice the current in the field coil, as shown in Fig. 2. It is claimed that by the connections shown in Fig. 2 (and reproduced in Figs. 4 and 5), the starting torque is doubled for the same current and same commutation as would be obtained with a compensated series motor.

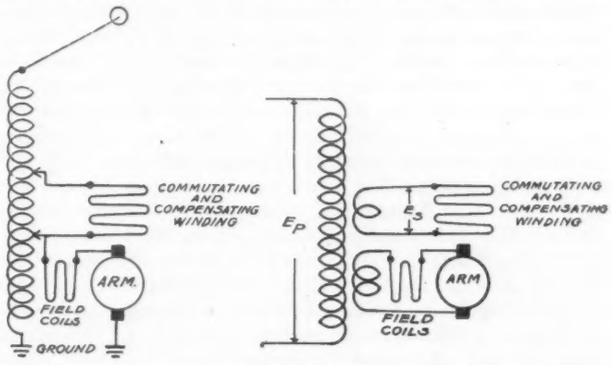
The electrical connections shown in Fig. 3 are reproduced in Fig. 6, which indicates also the magnetic relations. The circuits of Fig. 7 are electrically and magnetically equivalent to those of Fig. 3. The performance characteristics of the motor of Fig. 7 are similar to those of a compensated single-phase motor, but the action throughout the commutation zone is quite different. In the motor of Fig. 7 the flux along the



FIGS. 4 AND 5.—EQUIVALENTS OF CIRCUITS SHOWN IN FIGS. 1 AND 2.

brush axis depends solely upon the e.m.f. E_s, and is unaffected in any way by the current in the armature; the current in the compensating and commutating winding is a dependent variable, having a value such as not only to oppose the magnetomotive force of the armature current, but also to supply the m.m.f. to produce the flux demanded by the e.m.f. E_s. The cutting of this flux by the armature conductors under running conditions generates in the armature coil under the brush a speed e.m.f. that neutralizes the transformer e.m.f. produced in this coil by the alternating field flux.

It is interesting to examine the required value and time-phase position of the commutating flux. The transformer e.m.f. of the field flux varies in value solely with the field strength, and is always in time quadrature therewith; it is unaffected by the speed, except to the extent that the speed may alter the field strength. The speed e.m.f of the commutating flux is in time-phase with this flux and it varies in value with both the flux and the speed. It is seen, therefore, that the commutating flux should be in time-quadrature with the field flux and it should decrease in value as the speed increases. When the connections shown in Fig. 7 are used the commutating flux is always in time-quadrature with the e.m.f. E_s (or E_p). Now, under speed conditions, the current through the armature



FIGS. 6 AND 7.—EQUIVALENTS OF CIRCUITS SHOWN IN FIGS. 1 AND 3.

and field circuits is approximately in time-phase with the e.m.f. E_p. Hence, the field flux, which is in time-phase with the field current, is almost in time-quadrature with the commutating flux. Fig. 2 shows the arrangement of connections which allows the e.m.f. E_s, and therefore the commutating flux, to be decreased as the e.m.f. impressed across the motor field and armature circuits is increased, or as the speed increases.

It is stated that the commutation of the machine at a frequency of 25 cycles is much better than that of a conductively compensated series motor at the same frequency, and even better than that of the latter motor at 15 cycles. This result is due largely to the use of the connections described above, although some improvement is attributed to the use of a fractional-pitch winding on the armature. The latter improvement is said to be of the same character as that accompanying the change from an ordinary direct-current machine to a commutating-pole machine. The introduction of the commutating flux tends to lower the power factor slightly, but the greater liberty in design that is gained in the new type allows the motor, as constructed for railway service, to possess practically the same power factor as does a conductively compensated series motor for the same duty.

Electricity in Buffalo Grain Elevator Service.

Electricity from Niagara applied to grain-elevator service in Buffalo has surpassed steam in economy. Exact figures of what it costs to elevate grain by steam are difficult to secure, for the kind of grain handled, the time required and other conditions complicate the problem. It is conservative, however, to estimate the cost of handling grain by steam power at from 50 to 75 per cent above the expense per bushel by electricity. There are no stand-by charges with the electrical installation, and the depreciation of motors and controlling apparatus is much less than the depreciation of an idle steam plant. Intermittent service is readily handled by electric power, and the question of licensed attendance becomes of small moment.

In Buffalo some of the largest grain elevators are operated by electricity supplied by the Cataract Power & Conduit Company. The standard rate for elevator power is 2.5 cents per kw-hour. One of the largest elevators equipped is the Mutual, which has 27 motors of the induction type, making about 1240 horse-power connected load in this single installation. The maximum load of the Mutual elevator seldom exceeds 500 kilowatts. The maximum number of bushels of grain handled by this elevator in a 1907 month up to December was 2,372,000. The total capacity of this elevator is about 3,000,000 bushels per month. The motors here vary from 100 horse-power down. There are four 100-hp units driving the main outside elevator or "marine legs," four 75-hp motors on the inside legs, and nine 50-hp motors, driving belt conveyors and other apparatus.

These motors are all wound for two-phase, 440-volt current, and are supplied from the local distribution circuits of the company through two 500-kw, 2300-volt, three-phase to two-phase step-down Westinghouse transformers. This installation has been in satisfactory service for about 11 years. Auto starters are used in the motor circuits.

The Dakota elevator at Buffalo is equipped with 15 motors aggregating 930 horse-power connected load. This elevator runs at a capacity of about 1,000,000 bushels per month, and its maximum load is about 350 kilowatts. This is a three-phase installation with General Electric equipment. Three 250-kw transformers step the voltage down to 460 from 2300, the former being the working potential. The installation includes two 100-hp motors on the main legs, eight 75-hp, one 10-hp and four 30-hp motors. The motors are started on low voltage taps. The Great Eastern elevator has 20 Westinghouse induction 440-volt motors aggregating 912 horse-power, two of these being 150-hp outfits. Three 200-kw transformers wound for 2300 to 440 volts are installed in this establishment. In these elevators the service during six months of the year is generally intermittent. Owing to the different weights per bushel of corn, oats and wheat, and the storage of all kinds in a single elevator as well as the transfer and shifting of grain from boat to car and from bin to bin, it is difficult to give an accurate estimate of the power cost per 1000 bushels. In some cases, however, this has been figured considerably below 75 cents, and it is probable that it can in some instances be done for upwards of 50 cents. There is no question about the superiority of electricity for this work.

The Tantalum Lamp in Central Station Service at Muncie, Ind.

By Geo. C. Osborne.

Situated in the central part of the state of Indiana is the city of Muncie, possessing about the same opportunities and limitations to the central station as the ordinary city of 30,000 inhabitants. With an abundant supply of natural gas, distributed by five or six separate companies, and a widespread use of gasoline for individual lighting plants, the task of materially increasing the use of electricity for lighting cannot be called an easy one.

Under such conditions the Muncie Electric Light Company has during the past year obtained an income per capita increase of 40 per cent; connected lighting demand increase, arc lamps, 4 per cent; incandescents 23 per cent, and an enviable broadening of the peak of the lighting-load curve.

Much of this improvement is a direct result of the use of tantalum lamps, their application being widespread, included among its users being nearly all of the prominent stores, hotels, churches, theaters, and numerous residences.

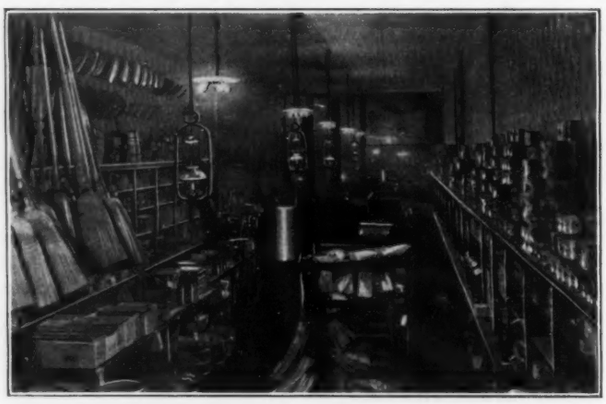
Mr. Fred Leslie, the present aggressive manager of the Muncie Electric Light Company, talks enthusiastically of the merits of the tantalum lamp and its aid in obtaining and retaining business which otherwise would have been lost to gas or gasoline. He relates many instances of customers voluntarily increasing the amount of money they were willing to spend on lighting, due to their adoption of the tantalum lamp and obtaining a whiter, a more brilliant and a steadier light. An ample tribute to their appreciation of the worth of the tantalum lamp is the 10,000 tantalum lamps now in use out of a total of 32,000 16-cp lamp equivalents connected. This appreciation is further attested by the fact that each lamp was sold at 60 cents, and that few converts again returned to the old carbon-filament lamp, which they could obtain at about 15 cents.

There are two methods of charging employed by the Muncie Electric Light Company, one, a straight meter rate, sliding from 10 cents to 5 cents per kw-hour, according to the total energy used, the low rate being given on all bills showing over 1000 kw-hours' use per month; the other, a flat rate of 60 cents a month for each 16-cp lamp connected (or lamp of equivalent wattage). On the meter rate, a customer increases his cost for lamp renewals and with a total increased cost, including renewals and energy charge, of from 10 per cent to 20 per cent (depending upon rate), he obtains continuously 60 per cent more light. On the flat-rate basis he gets this additional 60 per cent more light at a lower proportionate cost, varying with his average daily hours use of light. His total cost for lighting on an average daily use of two hours is increased by 2½ per cent; four hours, 5 per cent; eight hours, 10 per cent, etc.

It will be noticed that with the longer daily hours' use, although the cost for energy to a consumer on a flat rate is constant, his increased cost for lamp renewals on a lamp like the tantalum is sufficient to prevent a wilful waste of energy.

About one-half of the tantalum lamps installed are used on the flat-rate charge, under a two years' contract, the company in this case agreeing to furnish the customer with fixtures, sockets and porcelain shades.

It will be seen that the rate of 60 cents per month for each 50 watts connected produces $144 per annum per kilowatt connected, a lucrative return to the central station. This rate is attractive to the consumer only in connection with the tantalum lamp, giving 25 candle-power for 50 watts, instead of 16 candle-power, at simply the increased cost for lamps, which averages less than five cents a month for each outlet. Most of the stores have adapted their distribution of fixtures and sockets to the use of the tantalum lamp, thereby reducing the number of outlets and in that way deriving all the benefit of the superior efficiency of the new lamp.



TANTALUM LAMPS IN MUNCIE STORE; OLD GASOLINE LAMPS SHOWN.

Mr. George W. Tidd, formerly manager of the Muncie Electric Light Company, and now continuing his work with the American Gas & Electric properties, is a practical, hustling central-station man. He early saw the possibilities of the newer metallic-filament lamps, and while other companies were debating whether specific consumption of 2.8 w. p. c. or 2.5 w. p. c. should be adopted, Mr. Tidd reached out and secured the most efficient lamp available, and the result is to-day that Muncie is the best electrically lighted city in the Middle West. It is best from the consumer's point of view, because he is obtaining an abundance of light of a beautiful, brilliant white quality, and best from the central-station man's standpoint, as he is obtaining more and more business on the basis of $144 per year per kilowatt.

Tungsten Lamps for Leicester, Mass.

In connection with the purchase of the local electric lighting interests at Leicester, Mass., by the Worcester Electric Light Company, a plan has been developed to use tungsten series lamps in the street lighting of the town, which is a small village, located about 6 miles south of the Worcester Company's generating plant. The tungsten lamps to be used are to be operated in two circuits of about 100 lamps each. The company has purchased 400 of these lamps, but only 199 are as yet required by the town service. About 12 miles of wire will be

required in the town, and the new lamps will take the place of 25-cp, 3.5-watt, carbon-filament incandescents located on the same poles. The height of the lamps above the street will probably be from 15 ft. to 18 ft., and the existing spacing is in in the neighborhood of 100 yards between lamps, all being located on the same side of the street. The size of wire required on the circuit in the town will be No. 8 B. & S., and the total lighting load of the town will be supplied by two No. 0000 wires running from the Worcester mains at 2200 volts, single-phase, 60 cycles. The contract price for the service is at present $18 per lamp per year, the circuit being shut down at midnight.

The 40-cp series tungsten lamp is the smallest of this type manufactured. When operated at four amperes these lamps are figured at a consumption of 1.25 watts per candle-power. At Leicester the conditions are somewhat peculiar, however, in regard to the tub transformers located at a central point in the town, and the lighting contract calls for but 25 candle-power. The tubs are made for 3.5 amperes, and for these reasons the new lamp will probably be run at from 30 to 35 candle-power. This should give a long life without serious sacrifice of efficiency, though when the contract expires next summer it is likely that a new adjustment of rates may be suggested. The tubs cannot be run at much below three amperes. The plans for Leicester are somewhat tentative, but they illustrate the flexibility of a high-efficiency system in comparison with the older equipment.

LETTERS TO THE EDITORS.

The Neutral Commutation Zone.

To the Editors of Electrical World:

SIRS:—On page 1058 of your issue for Nov. 30, 1907, there appeared a brief reference to an article by me in the *Elektrotechnische Zeitschrift* which was so worded as to leave the impression that I believe that the brushes should not be displaced in order to obtain sparkless commutation in direct-current machines. According to my theory the brushes must be displaced because they must follow the displacement of the neutral zone, while, according to the usual theory, the brushes must be displaced beyond the neutral zone. Thus, although I hold that a perfect commutation takes place in the neutral zone, this zone is not stationary. I use the word "neutral" in its real sense, that is, devoid of magnetic polarity.

It may be well to mention the importance of definiteness in expression. It is not uncommon to find such a contradiction as "the magnetic field in the neutral zone." The expression "geometrical neutral line" is sometimes used when "symmetry line" is intended. In view of the indefinite and incoherent expressions used by certain authors it is not unnatural that they become confused in their own intricate explanations.

C. L. R. E. MENGES.

VILLA MAR, SCHEVENINGEN, HOLLAND.

The Patent Office Gazette.

To the Editors of Electrical World:

SIRS:—The many letters in your Jan. 11 issue relating to a recent change in the *Patent Office Gazette* show a remarkable diversity of views which ought not to exist if the real, practical utility of the *Gazette* is appreciated.

The publication of portions of patents in the *Gazette* has its greatest usefulness as a means of eliminating unnecessary work and unnecessary delays. This utility arises both when a representative of a manufacturer that might be affected by newly issued patents examines the *Gazette* week by week to obtain knowledge of patents that might be of interest, and also when the *Gazette* is used more in the manner of an encyclopedia. In either case the examination of the *Gazette* with reference to any particular patent will enable the searcher in a great number of cases to ascertain that the particular patent is of no interest, thereby obviating expense and the delay of waiting for a full copy of a patent. This, I think, answers the suggestion made by some of your correspondents that one must go to the full copy of the patent in any event before deciding upon the validity or scope of the patent.

No matter what plan is pursued as to the *Patent Office Gazette* it must necessarily be true that no one would attempt to decide that a patent is valuable by reading the *Gazette*, but in a great majority of cases it can thereby be decided that the patent is of no value. Where a manufacturer is interested in a line of work as to which numerous patents issue every week, it is of the greatest benefit to him that he can eliminate, by reading the *Gazette*, the great bulk of those that issue of no interest to him. The *Gazette*, therefore, should be published from the standpoint of giving to the reader as clear an idea of the general scope and character of the invention as it is possible to do without too great bulk. The old way was none too good, because, as pointed out by your correspondents, the drawings were most incomplete and the claims were often meaningless without reference to the specification. Frequently the drawings showed only old and familiar devices, while the claims related to automatic features in no way indicated in the drawings published. Yet, in most cases by reading over the claims, it could, at least, be determined whether the patent might have some relation to the purpose in view, or whether it clearly had none.

But the new way seems to me to be without excuse, because it is a purely arbitrary matter to select the five claims numbered one to five in the patent. It is emphatically not true even now that the most important claims are always among these first five. Without any attempt to draft claims in any unusual order, it frequently occurs that the broader claims have high numbers. Frequently this is the case because the full scope of the invention does not become at once apparent—it seldom does. Under the new arrangement it would be undoubtedly the case that a still smaller proportion of the patents would be drafted with the strongest claims among the first five. One might almost as well eliminate all the claims as arbitrarily to select the first five. Indeed, if an abstract prepared intelligently by the Patent Office were inserted, this would be superior to the present rule.

It is true that the *Patent Office Gazette* is getting exceedingly bulky and occupies valuable shelf space, but the removal of this annoyance should not be effected by any such artificial elimination as is now practiced. Either the old method should be revived, or what would be better, there should be an intelligent preparation of the matter that is to appear in the *Gazette*. Sufficient of the drawings should be selected by the examiner to enable the general character of the invention to be understood, and the examiner should prepare a brief digest of the object, nature and construction of the invention, and should select claims sufficient in number to enable the reader to know generally what features are claimed and how broadly they are claimed. In some cases a single claim and two lines of descriptions would be ample. In other cases perhaps a half-column of description and 15 or 20 claims might be necessary.

My point is that a change from the old order would be wise, but that it should be one that is based upon an intelligent and careful study of each individual patent. Thus the utility of the *Gazette* would be largely increased and its bulk would be much reduced.

NEW YORK, N. Y. RICHARD EYRE.

A Rectifier for Small Alternating Currents.

To the Editors of Electrical World:

SIRS:—While investigating the silicon wireless detector I discovered that it has remarkable unilateral conductivity which

causes it to act when properly adjusted as an effective rectifier for small alternating currents. Perhaps the following very brief preliminary account may be of interest to your readers.

The rectifier, as used in the experiments, consisted of a bit of silicon embedded in solder in contact with a piece of either brass or steel wire attached to a flat spring. The contact pressure could be varied by means of an adjusting screw. Some points on the silicon seem to have the rectifying property in a superlative degree, hence the point of contact was also made adjustable. In the following table a few values showing the marked unilateral conductivity are given:

Direct e.m.f.	Current in milli-amperes.	
Volts.	Brass to silicon.	Silicon to brass.
0.028	.008	.0075
0.042	.012	.0100
0.070	.021	.0160
0.14	.050	.0250
0.28	.300	.0800
1.00	8.400	.4000
2.80	47.000	2.8000

Alternating voltages at 60 cycles applied to the rectifier gave asymmetrical currents corresponding fairly closely to the differences in the two columns of the table.

For small voltages the rectification is roughly proportional to the square of the voltage, but for the higher values it increases more rapidly, reaching 91 per cent at 1.0 volt. Above this the whole phenomenon appears to be more irregular and the rectification becomes gradually less complete, at least with the present arrangement of contacts. Observations at 900 cycles and with high frequency currents indicate that the rectification is at least approximately independent of the frequency.

The cause of the peculiar unilateral conductivity is not yet by any means clear, but it seems from the present evidence that it is a surface phenomenon, depending vitally as it does on the position and pressure of the contact. The most effective contact resistance appears to lie between 1000 and 4000 ohms. With the silicon in contact with solder electrodes at both ends, well pressed together so that the resistance falls to a few ohms, the phenomenon practically disappears.

In the experiments mentioned above the action cannot be thermoelectric, for apart from the magnitude of the effect, the current produced by heating the brass-silicon junction has the reverse direction. It is possible, however, to make an adjustment of the contact pressure so that the rectified current, at least in the case of low voltages, coincides with the thermoelectric current. This is a condition in general difficult to secure or to maintain.

G. W. Pickard, in his patent specification No. 836,531, states that this last method of working is the one operative in the silicon detector, and he considers the action thermoelectric.

Bureau of Standards, Washington. Louis W. Austin.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

The Torque of Alternating-Current Motors.—V. A. Fynn.—A very long paper read before the Birmingham Section of the (British) Institution of Electrical Engineers on the torque conditions in a number of different types of alternating-current motors. The author first deals at considerable length with what he terms the "self-exciting, partly-compensated single-phase induction motor," commonly called the single-phase induction motor, and traces the three different components into which the torque may be considered as divided, and also indicates some methods by which some motors may be fully compensated. He then deals more briefly with the "separately-excited series-induction motor," known as the Atkinson repulsion motor; the "neutralized series-conduction motor," which is the compensated series motor; the "partly-compensated, separately-excited series-induction motor," otherwise called the Latour motor; the "partly-compensated, self-excited series-induction motor," and the "separately-excited, partly-compensated two-phase shunt-induction motor," which is the two-phase induction motor. Some methods of starting "single-phase, self-excited compensated-induction motors" are discussed, and a comparison of the specific weight of direct and alternating-current motors is made. He states as a basis for comparisons that the weight of a commercial continuous-current motor, as compared to that of a commercial 50-cycle, single-phase "self-excited partly-compensated shunt induction motor" with slip rings, is as 1 to 1.5, and that the weight of the continuous-current machine, as compared to a commercial 50-cycle, two-phase, partly-compensated, shunt-induction motor with slip-rings, is as 1 to 0.7. In cases where a commutator is used the weight is, of course, increased, but where such a commutator can be fully utilized in a rational manner, as is, for instance, the case with constant-speed machines, the increase in weight is fully compensated for by a correspondingly increased output. In other cases the use of a commutator leads to an increase in weight without a corresponding increase in output, as in the case of motors with a series characteristic. This increase in weight is from 20 to 25 per cent, varying with the type of machine. Of course, these figures are merely approximations; that is, if the design of the different types of machines is analogous. "The difference in the design-constants between commercial continuous and commercial alternating-current motors is most marked in the case of the continuous-current series traction motor as compared to the 'neutralized single-phase, series-conduction' machine. The armature ampere-turns of the latter very greatly exceed those of the former in a motor of equal output and same speed, with the result that the weight discrepancy between the two can often be reduced below the limit given, although this particular type of alternating-current motor requires a heavy cummutator. Thus, with a sinusoidad current wave and a periodicity of 25 cycles, the alternating-current machine for the same heating need be only about 40 per cent heavier than a continuous-current series motor of the same output, speed and voltage." An account of the discussion which followed is also given.—Lond. *Elec. Eng'ing,* Dec. 12, 19, 26.

Design of Direct-Current Generators.—H. M. Hobart and A. G. Ellis.—The first part of a second serial on the influence of the rated speed and output on the design of direct-current generators. In their former serial they described a method of determining the leading dimensions of direct-current generators of any rated output and speed, chiefly with reference to the reactance voltage as the commutation criterion. They also obtained the leading data for a 500-kw, 250-volt, direct-current generators for speeds between 125 and 2000 r. p. m. In the present serial they extend these considerations to designs for 250 and 1000 kilowatts for the same speeds. They also give some results of working out in detail a number of designs for the same rated outputs at high and low speeds.—Lond. *Electrical Review,* Dec. 20.

Voltage Coefficient.—A. Seugel.—In the equation of the effective value of the e. m. f. of an alternating-current machine $E = K N z f 10^{-8}$ (where N the useful number of lines of flux per pole, z the number of conductors per phase, f the frequency), the "voltage coefficient K depends considerably on the arrangement of the coils and poles. The author gives formulas for calculating this coefficient for the usual winding arrangements of single-phase and polyphase machines. A comparison of the values of K for the voltage between one phase and the neutral point and the voltage between two phases in polyphase machines shows that the ratio of the two voltages is not always the same, but depends partly on the arrangement of the poles and coils.—*Elek. Zeit.,* Dec. 12.

Three-Phase Induction Motors.—W. OELSCHLAEGER.—The plotting of the circular diagram of an induction motor depends on the knowledge of the magnetizing current and of the ideal short-circuit current. The former may be easily calculated, but the latter is generally found from the former with the aid of the leakage coefficient. This method has distinct disadvantages and the author describes a simple method for determining the ideal short-circuit current directly from the main dimensions of the machine. The method is based on the introduction of the term "number of ampere-conductors per unit of periphery for the ideal short-circuit current."—*Elek. Zeit.*, Dec. 26.

Mercury-Vapor Rectifiers.—J. POLAK.—A translation in abstract, with illustrations, of his German paper, abstracted some time ago in the Digest, on the practical operation of mercury-vapor rectifiers.—Lond. *Electrical Review*, Dec. 13.

Lamps and Lighting.

Effect of Light on the Eye.—SCHANZ AND K. STOCKHAUSEN.—The authors, one of which is an eye specialist, have determined the effect of light on the human eye, and especially the effect of the ultra-violet rays. The eye is the more strongly affected by artificial sources of light the greater the brightness in candles per sq. cm. and the greater the area of the source of light. The maximum brightness which the eye can withstand without bad effect is 0.75 hefner candles per sq. cm. Only paraffine candles, oil lamps and certain special kinds of kerosene and gas lamps are below this limit. Any other source of light should be surrounded by a diffractive globe. Carbon-filament incandescent lamps have a brightness 100 times the allowable limit, metalic-filament lamps 270 times, the Nernst lamp 550 times, and the electric arc lamp 4000 times (evidently meaning incandescent lamps with plain globes and the Nernst filament and the arc without any globe). Lamp cylinders or globes must be made of glass so that the ultra-violet rays are absorbed. Incandescent lamps with plain globes should not be used for lighting working rooms and school rooms. Indirect illumination is in any case preferable.—*Jour. f. Gasbel.*, Vol. 50, 1907, p. 988, 1029 and 1070; *Elek. Zeit.*, Dec. 26.

Arc Lighting in London.—An article giving comparative curves of the illumination obtained in London streets partly with enclosed arc lamps on short lamp posts (13¾ ft. high), partly with white flame lamps placed on posts along the curb (20½ ft. high), and partly with yellow flame lamps suspended over the middle of the road (28 ft. high). The latter method of center suspension is possible only where the width of the street is suitable, and it introduces difficulties in trimming and attending to the lamps. It seems that in the third case the lamps had to be hung too high. If suspended at a lower height they would have given more illumination. On the other hand, although the maximum illumination is less than in the case of lighting from lamps along the curb, the drop variation from maximum to minimum is not so marked. The ordinary enclosed arc lamps are provided with unusually large opaque globes. "Complaints have been made of the glare of the flame arc and the unpleasant effect of the white arc when not obscured, and every means appears to have been taken to obviate any trouble of this kind. These lamps (the enclosed arcs) give a measured candle-power of 300 at all angles below the lamp level, with a large light flux in all directions, thus giving clear illumination without harsh shadows, and the comparatively low intrinsic brilliancy of these lamps in the line of vision has the merit of enabling the even distribution of illumination to be more appreciated by the eye."—Lond. *Elec. Eng'ing*, Dec. 12.

Electric Lighting of Railway Cars.—K. WALLITSCHEK.—An illustrated description of different systems of electric car lighting in use on Austrian railways. Besides a notice of the system of Stone and Boehm, those of Digg and Rosenberg are described to some extent.—*Elek. und Masch.*, Dec. 15 and 22.

Power.

British Power Company.—An article giving details of extended developments which have taken place in the motor load in some districts of the West Ham Corporation system. Two-phase induction motors are almost exclusively used, and a separate 6000-volt, two-phase cable system has been laid for motor service. Further developments are expected in connection with electrolytic work and factory heating purposes. The corporation hires out motors, arc and incandescent lamps, and act as contractors for wiring. Much of the extension of business is due to the activity of the canvassing department.—Lond. *Elec. Eng'ing*, Dec. 12.

French Water-Power Plant.—H. ARMAGNAT.—In a continuation of his long serial on the electric stations along the Mediterranean coast of France, the Brillanne power plant is described. There are five generating units of 3000 kv-amperes. Each generator is driven by a double Francis horizontal turbine, and generates three-phase currents at 7500 volts at a frequency of 25. There are also some smaller machines for excitation and for furnishing the lighting current in the vicinity of the station. By means of a transformer sub-station it is possible to connect this system with other distribution systems in the neighborhood.—*L'Industrie Elec.*, Dec. 25.

Gas-Electric Power.—An illustrated description of the electric equipment of mines and metallurgical plants which is now going on in the celebrated Mansfeld copper district of Germany. The different generating stations are connected together to a ring so that in case of an accident in one station the other stations may act as reserves. The interesting feature of the installations is the utilization of the gases from the copper blast furnaces for producing electric energy in gas engines. Electricity is used for lighting and all kinds of industrial purposes, of which the most interesting are the winding equipment in the different mines. The great economy of electric motors over steam engines is shown.—*Electrochem. and Met. Ind.*, January.

Electric Motors in Railway Shops in Argentine.—An illustrated description of the electric equipment of the new workshops of the Buenos Ayres, Western Railway. The machinery throughout the works is electrically driven on the three-phase system at 440 volts. The generators are driven by gas engines, producer gas being supplied by two Mond producers, the fuel being bituminous slack.—Lond. *Elec. Review*, Dec. 20.

Electric Winding in Mines.—E. KULKA.—A mathematical article illustrated by diagrams for solving the different problems arising in the operation of electrically operated winding machines, especially at starting and stopping with constant current.—*Elek. Zeit.*, Dec. 12.

Electric Motors in Coal Mines.—An illustrated article of a general nature on the uses of electric motors in coal mines, especially for pumping, winding and the operation of compressers, drills and coal cutters.—*Cassier's Magazine*, January.

Assessment of Tramway Companies.—J. F. C. SNELL.—An article in which the author reviews the methods of assessing electricity supply of tramway undertakings for the payment of taxes, and summarizes the decisions that have been given in Great Britain from time to time on various disputable points. Tables are given of the estimated life of the various kinds of plant machinery, and a comparison is made of the taxes paid by some typical electricity supply and tramway undertakings, expressed as percentages of the capital expenditure.—Lond. *Elec. Eng'ing*, Dec. 12.

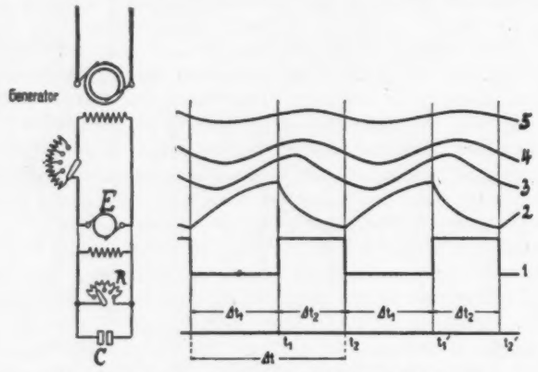
Traction.

Signals for Locomotives.—J. PIGG.—*A* paper read before the (British) Institution of Electrical Engineers on a system of electrical cab-signalling on locomotives which has been put into experimental use by V. Raven on the North-Eastern Railway. In addition to repeating visually the indications of the semaphore, the instrument on the engine carries two pointers, which serve as route indicators, and a failure indicator for showing when the circuit of the local battery actuating the apparatus is out of order. An electric bell is used to give audible signals. A series of several contact-ramps between the rails required between the distant signalling point and the home signal, as well as a pair of spring bars outside the rails, actuate a rotary switch on the engine at the point where the driver's attention is first called. Several railway men took part in the discussion. Practically all admired the ingenuity of the system, but there was a tendency to regard it as too complicated and too

expensive. Other causes of criticism were that in the event of failure of the local battery, the normal audible danger signal is not given, but only an entirely different visual indication, which the driver might neglect. The use of the same bell for both the danger and line-clear signal was also condemned, as well as the normal danger position of the miniature semaphore arm in the cab instrument. While the consensus of opinion favored indications in the cab, one speaker preferred loud audible signals alongside the track. The possibility of extending the action of the cab apparatus to actually stopping the train, as well as warning the driver, was discussed, as was also the extent to which such a system should be supplementary, or should replace, ordinary semaphore signals.—Lond. *Elec. Eng,ing,* Dec. 12.

Installations, Systems and Appliances.

Tirrill Automatic Voltage Regulator.—G. Grossmann.—A very long and profusely illustrated Berlin Electric Society paper on the modern Tirrill regulator. As indicated in Fig. 1,



FIGS. 1 AND 2.—AUTOMATIC VOLTAGE REGULATOR.

the action depends on a mechanism in continuous movement which periodically closes and opens a pair of contacts C, whereby the resistor R in the shunt-excitation of E is periodically short-circuited. E is the machine furnishing the exciting current for the generator shown at the top. In Fig. 2 the periodical variations in the resistance of the shunt-excitation circuit of E are shown in curve 1; they vary periodically between a maximum and a minimum. Curve 2 represents the exciting current of E, curve 3 the excitation voltage, curve 4 the exciting current of the generator, and curve 5 the effective generator

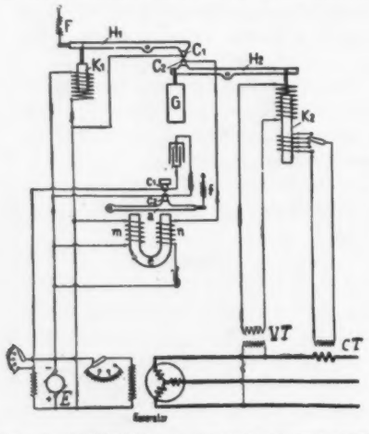


FIG. 3.—DIAGRAM OF VOLTAGE REGULATOR.

voltage which is periodically fluctuating. These curves relate to the conditions when load and speed of the generator do not vary. The object of the regulator is to maintain the average effective generator voltage constant whatever the speed and load. This is accomplished by automatic adjustment of the exciting current of the generator. This exciting current must vary between a minimum value, corresponding to no-load at maximum speed, and a maximum value, corresponding to full-load at minimum speed and with minimum power-factor. In a special case it may, for instance, be necessary that the excitation voltage varies between 50 and 100 volts. The connections of the regulator are shown in Fig. 3. The periodic short-circuiting of the resistor (R in Fig. 1) is obtained by the pair of contacts c_1c_2 (Fig. 3). The upper contact (c_1) is stationary, while the lower, c_2, is fixed to the armature of the differential relay e. The latter is provided with two equal and opposite windings, m n, both of which are connected to the source of excitation voltage, but while the current exists continually in one, it exists in the other only when the main pair of contacts C_1C_2 (at the top of Fig. 3) is closed. Therefore, if C_1C_2 is closed the magnetic flux in e is zero; if C_1C_2 is open there is a flux in e and the armature is attracted. The opening and closing of the two pairs of contacts C_1C_2 and c_1c_2 is practically synchronous. The regulating mechanism consists essentially of two main parts. At the left-hand there is the direct-current magnet acting on the lever H_1 with the upper contact C_1. At the right-hand there is an alternating-current magnet acting on the lever H_2 with the lower contact C_2. The winding of the direct-current magnet at the left is in series with a non-inductive resistor and is connected to the terminals of the exciter so that the current in it is proportional at any time to the excitation voltage. This solenoid attracts the iron core K_1 downwards, which is counteracted by four spiral springs drawing the lever H_1 upwards. These are so arranged that the combined torque of the different springs varies approximately according to the same law as the electromagnetic tractive force, which increases the more the further the core is drawn into the solenoid. It can be so arranged that the distance to which the upper contact C_1 is raised is proportional to the change of the excitation voltage. In reality the excitation voltage constantly fluctuates, so that the lever H_1 and the contact C_1 oscillate continually with great speed around an average position which varies with the load of the generator and the excitation voltage. At the right-hand is the alternating-current magnet; VT and CT are a shunt transformer and series transformer, respectively, connected to the generator, as shown. The current in the alternating-current magnet has at any time an effective value proportional to the generator voltage. This solenoid acts on the iron core K_2, suspended on the lever H_2, while G is a counterweight. The two forces that act on H_2 are gravity and the magnetic tractive force. The latter depends on the position of the core relative to the solenoid and on the effective generator voltage. By proper design it is possible to obtain the following result for a certain predetermined normal voltage of the generator. As long as this generator voltage is maintained constant, the alternating-current lever H_2 is perfectly balanced in any position. If, however, the generating voltage decreases, a torque is exerted on the lever in a clockwise direction, and the torque and the voltage vary together. If, however, the generator voltage increases above the normal value, a torque is exerted in a counter-clockwise direction. The author shows in detail how the continuously moving mechanism operates as long as the load and speed of the generator are constant. The movement of the mechanism remains perfectly regular during this time. But if, for instance, the load is increased, and, therefore, the voltage decreases below the predetermined normal value the lever H_2 is acted upon by a torque in a clockwise direction so that the main contacts C_1C_2 are closed and the shunt regulator is short-circuited. The exciting current immediately increases until the voltage has again reached its normal value. If the voltage then rises above the normal, the main contacts C_1C_2 which were continually closed up to this moment are opened again and the oscillating movement begins again. While, as explained above, the generator voltage is continually fluctuating, the fluctuations are so small and so rapid that they are of practically no importance whatever. In general, the contacts make from 400 to 900 oscillations per minute. Some diagrams are reproduced to show a very great superiority of this automatic regulator over the most careful hand regulation, even with very strong fluctuations of load. Whenever there is a very great change in the load there is a small variation of the generator voltage, not more than 0.3 to 0.5 per cent, which, more-

over, does not last more than a few seconds. The author thinks that the excellent properties of this regulator are due mainly to the ingenious construction of the lever H_2, which is not acted upon by forces of springs, but represents a system in unstable equilibrium which is able to react on the smallest impulse. As shown in Fig. 3, the alternating-current magnet has not only a winding influenced by the generator voltage and fed from the voltage transformer, but also a second one which is supplied with current from a series transformer. This second winding is adjustable, and in this way it is possible to vary the value of the generator voltage to be maintained constant. In practical constructions the voltage to be maintained constant may thus be adjusted within limits of 15 per cent. With the aid of this second winding it is also possible to obtain an automatic increase of the generator voltage proportional to the generator load, which method is useful if one wants to keep the voltage constant at a distant point, for instance, at a feeding point. The very long paper describes all the details of the apparatus at length.—*Elek. Zeit.*, Dec. 12, 19 and 26.

Mainz.—FURKER.—An article on the equipment and development of the municipal central station of Mainz, in Germany. The object is to show that a three-phase system can be developed properly and economically in a city which has comparatively few industrial plants compared with the number of inhabitants. In such a case, however, the management of the plant should make use of all the most modern improvements in boiler house economy, machine construction, etc., so as to use the fuel always in the most rational way. It is also emphasized that municipal stations need not be less economical than private plants. It is important to meet the requirements of the consumers in every way and to adjust the rate for electric energy so that even the smallest merchants can use electricity.—*Elek. Zeit.*, Dec. 5, 12, 19.

Electric Equipment of an Hospital.—An illustrated description of the electric installation of the Royal Victoria Infirmary at Newcastle-on-Tyne, where electricity is used for lamps, for all kinds of industrial purposes, in the kitchen, in the dispensary (rotary mixers), in the laundry, etc., as well as for the operation of radiographic apparatus, electric baths, Finsen lamps and for Roentgen rays in skin diseases.—Lond. *Elec. Review*, Dec. 13.

Wires, Wiring and Conduits.

Lamp Socket.—An illustrated description of a device of Magunna, shown in Fig. 4, to connect, for instance, a lamp to

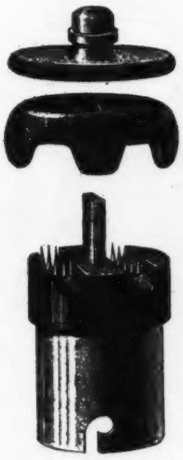


FIG. 4.—LAMP SOCKET.

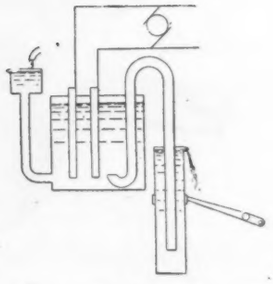


FIG. 5.—ADJUSTABLE WATER RESISTOR.

two conductors. The two conductors are placed into the two grooves at the top of the base shown at the bottom of the illustration. Then the insulating piece shown in the center of the illustration is dropped into place and finally the metallic knob shown at the top is screwed on. As a result of the pressure thus exercised, the sharp points in the grooves penetrate through the insulation of the wires and make contact with the copper. A lamp may then be connected.—*L'Industrie Electrique*, Dec. 25.

Electrophysics and Magnetism.

The Parent of Radium.—HAHN.—It has formerly been suggested that radium is produced from uranium, though it was later shown that there must be one or more intermediate products between the two. Boltwood offered the hypothesis that actinium is the direct mother substance of radium, but Rutherford showed that it is not actinium, but some unknown substance present with the actinium. Boltwood has since found that this hypothetical element, which he calls ionium, follows the reactions of thorium. The present author has also found in another way that the direct parent of radium follows the chemical reaction of thorium and can thus be obtained from uranium minerals.—*Berichte*, XI, p. 4415; *American Jour. of Science*, January.

Electrochemistry and Batteries.

Steel Furnace.—THALLNER.—A paper on the refining of steel in the electric furnace. The author points out that the electric furnace is not a simple melting furnace, but that its chief advantages rest in the possibility of using special slags which can be used only at the high temperature available, and which enable a very complete refining of the metal. This is especially possible with the Heroult furnace, in which not only may the sulphur and phosphorus be reduced to any desired amount, but the metal may be obtained free from oxides. A diagram gives the consumption of electric energy in the Heroult furnace with hot and cold starting materials for different sizes of furnaces.—*Electrochem. and Met. Ind.*, January.

Modification of Induction Furnace.—WEDDING.—An illustrated description of a modification, due to Roechling and Rodenhauser, of the electric induction furnace for steel making in use in a German steel works. It is in reality a combination of an induction furnace with an electrode furnace, the electrodes being connected to a second secondary winding (the first secondary being the metal bath as in the ordinary induction furnace). The electrodes are made of refractory electrolytic conductors of the same nature as the filament of the Nernst lamp, which are non-conductors at low temperatures and become conductors only at elevated temperatures. They are preheated by the bath, while the furnace acts simply as a pure induction furnace. Some details of the metallurgical problems of refining are given.—*Electrochem. and Met. Ind.*, January.

Electrothermic Production of Iron and Steel.—J. W. RICHARDS.—The first part of an illustrated Franklin Institute paper. After general introductory notes on the subject, the author discusses the induction furnace, the Héroult furnace, and the ferroalloy industry.—*Jour. Franklin Institute*, December.

Units, Measurements and Instruments.

Adjustable Water Resistor.—F. ROSS.—For testing large alternating-current generators water resistors are quite convenient, but it is preferable not to adjust the resistance by raising or lowering the electrodes or changing the distance between them, but by varying the level of the water. Fig. 5 shows the arrangement. It is best to use running water so as to prevent any considerable raise of the temperature. In general, a supply of one-third litre of water per minute per kilowatt is amply sufficient. The adjustment of the level is accomplished, with the aid of the tube, by raising or lowering the vessel at the right-hand of the illustration. The method is exceedingly simple, and is free from danger even with high-tension currents.—*Elek. und Masch.*, Dec. 8.

Silver Voltameter.—R. T. GLAZEBROOK.—A Royal Society paper giving the results of an investigation made in the British National Physical Laboratory. F. E. Smith and T. Mather have compared many forms of silver voltameters and have determined the electrochemical equivalent of silver. They conclude that "the Rayleigh form of voltameter as employed by them is reproduced to one or two parts in 100,000, and that the electrochemical equivalent of silver is 1.11827 milligrams per coulomb." In a second part of the paper the chemistry of the silver voltameter is discussed by F. E. Smith and T. M. Lowry.—Lond. *Electrical Review*, Dec. 13.

Induction Coils.—B. Zirotka.—In order to avoid the use of an interrupter for the operation of Roentgen-ray tubes, wireless telegraphy, etc., the author endeavored to employ directly alternating currents from an ordinary supply network with the aid of an induction coil. He found that the voltage could be very essentially raised by employing two spark-gaps, as shown in Fig. 6, which indicates the arrangement for the operation of a Roentgen-ray tube. It will be seen that the two spark-gaps are connected opposite. The second spark-gap, which is earthed, is intended to carry off the current pulses of the polarity, which is not desired. In this way it is possible to get current impulses of uniform direction and to increase the voltage of the induction coil by about 100 per cent. Data are given on the design of an induction coil for such purposes.—*Elek Zeit.*, Dec. 12.

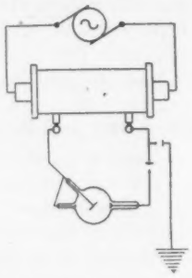


FIG. 6.—DIAGRAM OF INDUCTION COIL.

Measuring Damping Effects.—H. Rausch von Traubenberg and B. Monasch.—If the electromagnetic oscillations produced in a condenser circuit with air gap are caused to act on a resonance circuit, the form of the resonance curve in the second circuit depends on the sum of the damping factors or logarithmic decrements of the two oscillators. If the damping of the secondary system is to be determined a resistance whose value is known is added, etc. The authors show that much more exact results can be obtained by using continuous oscillations of constant amplitude produced by the Poulsen arc method.—*Phys. Zeit.*, Dec. 15.

Electrolytic Meter.—H. S. Hadfield.—An article describing some recent improvements in the Wright mercury electrolytic meter. After describing the original Wright meter and its practical defects due to the changes in the mercurous nitrate electrolyte the author describes his experiments made with other electrolytes which lead him to adopt a solution of a double iodide of mercury and potassium. As cathode either tantalum or sand-blasted pure iridium are most satisfactory. The meter is to be put on the market.—Lond. *Electrician*, Dec. 6 and 13.

A Repulsion Meter for Alternating Currents and Potentials.

By John M. Lea.

The field of electrical measurement comprises two different kinds of currents, direct and alternating. The practical measurement of the unidirectional currents and potentials is very satisfactorily accomplished by the Deprez and D'Arsonval type of instrument making use of a powerful permanent magnet and a very light pivoted coil. In practical measurement of alternating currents and potentials, however, much more difficulty is experienced, and the types of measuring instruments now in use are inferior in several respects to direct-current meters.

The most prominent and common of alternating-current measuring instruments are the dynamometer, hot wire, induction and "magnetic vane" or electromagnetic types.

The repulsion type of induction meter is as valuable as any of the forementioned, and, in addition, is very efficient and has a scale which is more even than that of any other type of alternating-current ammeter or voltmeter. A meter of this type patented by the writer and manufactured by the International Electric Meter Company, of Chicago, is shown herewith. Fig. 1 illustrates the moving element or coil, with index and pivots. The coil stamping, which is composed of aluminum, is only 8 mm in thickness, and is made so nearly balanced that very little counterweight need be added to the moving parts for poising or balancing and, therefore, the whole system is extremely light. This is a well known advantage for electrical measuring instruments. When complete with pointer, counterweights and pivots the weight is only 35 grains.

A clear idea of the instrument, its principles and its action may be obtained by reference to Fig. 3. In its elements this instrument embodies the principle of a short-circuited transformer, consisting of a primary or exciting coil *A* adapted to carry the current or a part of the current to be measured, and a secondary element or closed coil *B* linked in inductive relation to the primary by a suitable laminated iron core *C*, constructed to give a completely closed magnetic circuit. The primary and secondary, just mentioned, are so mounted as to have a relative movement under the influence of their mutual repulsion when the primary is traversed by an alternating current. Such movement of the secondary *B* is opposed by two tempered phosphor bronze spiral springs (acting in opposite directions to eliminate "zero" trouble), so that the extent of movement will be dependent upon the strength of the primary current and will indicate such strength of current. To increase the sensitiveness of the instrument, the adjustable secondary circuit *D*, which has an attractive effect, is provided upon the core near the extremity of the swing of coil *B*. The magnitude of this effect is proportional to the distance of this secondary from the end of the swing of the coil *B*, the further away the less the effect. This feature is made use of in adjusting the contour of the scale in calibration, as without it the divisions would tend to shorten, and the result is a very even scale throughout 70 per cent of the deflection.

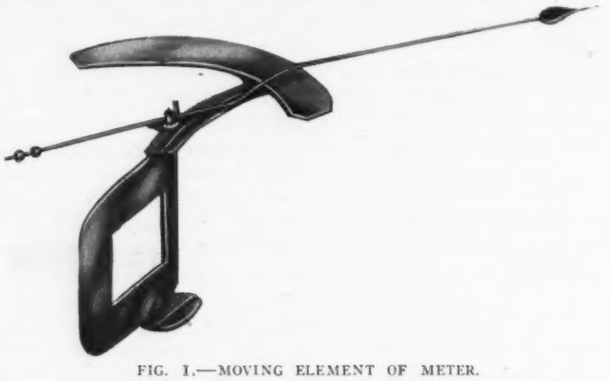


FIG. 1.—MOVING ELEMENT OF METER.

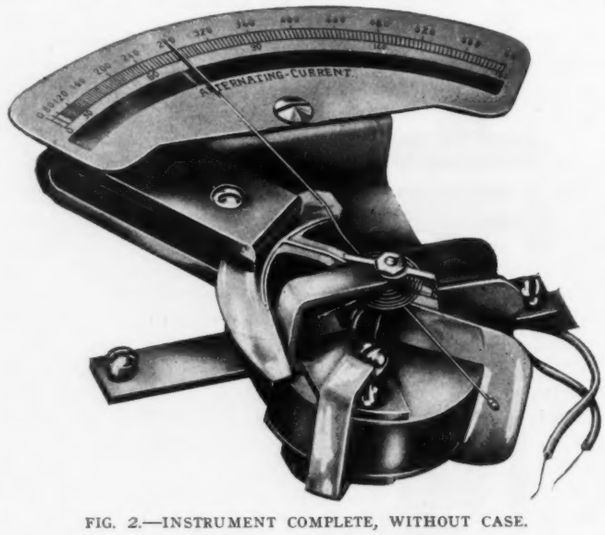


FIG. 2.—INSTRUMENT COMPLETE, WITHOUT CASE.

Thus, the movable secondary coil *B* is arranged to oscillate along the curve of the core *C* between the fixed primary *A* and the adjustable or fixed secondary *D*, being simultaneously repelled by the primary and attracted by the secondary. The

action of the coil *D* allows a considerable reduction in the section of the coil *B* as it may be said to carry part of the active induced current. It can be made of considerable cross-section and of heavy metal with impunity. This allows the use of a metal of zero temperature coefficient, and thereby greatly reduces the temperature coefficient of the meter.

The vane *E*, which is a part of the coil stamping, is adjusted to swing freely and with a large amount of clearance between the poles of a strong permanent magnet *F*, which acts as a dampener on the oscillations of the moving element, but does not cause any friction or in the least affect the accuracy of the calibration. This magnet is not affected by the action of the alternating flux, as it is mounted in a position where there is very little leakage, the magnetic density in the core being exceedingly low.

Changes in the wave-form of the primary current have no appreciable effect on the indication of this meter as the greatest

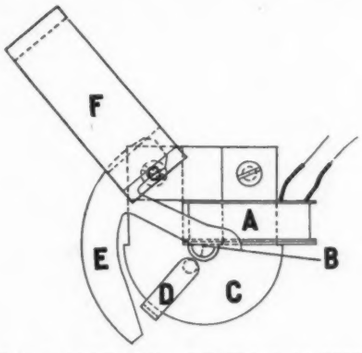


FIG. 3.—DIAGRAM ILLUSTRATING PRINCIPLES OF REPULSION METER.

possible change, caused by change in wave form, is only 4 or 5 per cent of the core loss, while the probable change is much less and besides this the core loss is only a very small part of the total power required to overcome the I^2R loss in the coils and other losses.

The meter has a power-factor of from 60 to 70 per cent, and as the reactance is not affected by temperature changes, the meter is inherently less affected, by this cause, than is ordinarily the case. There are three additional provisions made to eliminate this effect in both ammeters and voltmeters.

New Model of Mercury Vapor Lamp.

The Cooper Hewitt Electric Company, of New York, has brought out a new model of mercury vapor lamp which embodies several mechanical and electrical improvements that add greatly to the commercial value of the lamp. The general form of the vapor tubes of the several types of lamps remain the same, the improvements, for the most part, being in the "auxiliary" and the method of installation. The new design makes it possible to handle each lamp outfit as a unit, and has simplified the hanging of the lamp.

No change has been made in the parts and functions of the auxiliary to the lamp tube, the improvements being embraced in the manufacture and assembling of this device. The new casing of the auxiliary resembles that of the ordinary arc lamp. As shown in Fig. 1, the cover is hinged, and when thrown open gives easy access to the parts of the auxiliary. The lamp rod which supports the vapor tube is attached by a pivot screw to the auxiliary.

Fig. 2 shows the details of the auxiliary. A ceiling plate, a short, threaded, pipe nipple and an insulating joint are furnished with each lamp outfit. These are fastened to the ceiling, and the auxiliary is screwed to the insulating joint. Where lamps are hung from outlet boxes, the ceiling plate can be dispensed with. When desired, the lamp may be hung from a wire rope by screwing a hook to the insulated joint and guying the lamp so that it cannot swing. The ballast or adjuster is fitted with a standard plug base and screwed into an Edison socket. The inductance coils are thoroughly insulated, and the resistor is made of wire entirely embedded in an enamel-coated spool which protects it from gases and dampness. Two binding posts are provided on the resistor for adjustment of the potential. Close regulation is not necessary, as the ballast and induction

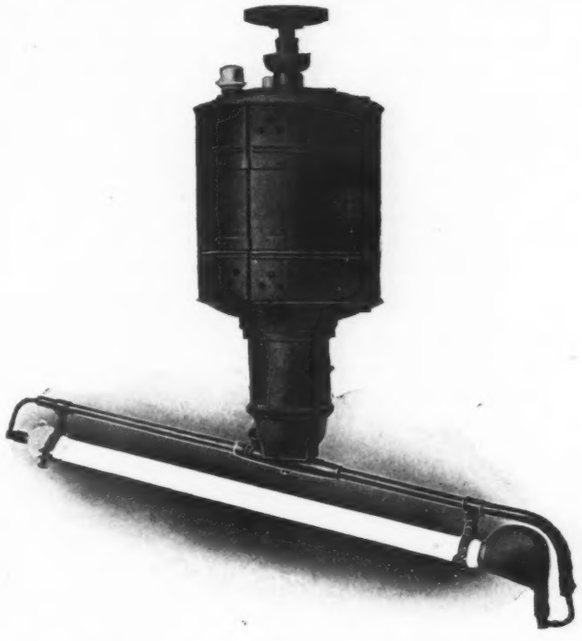
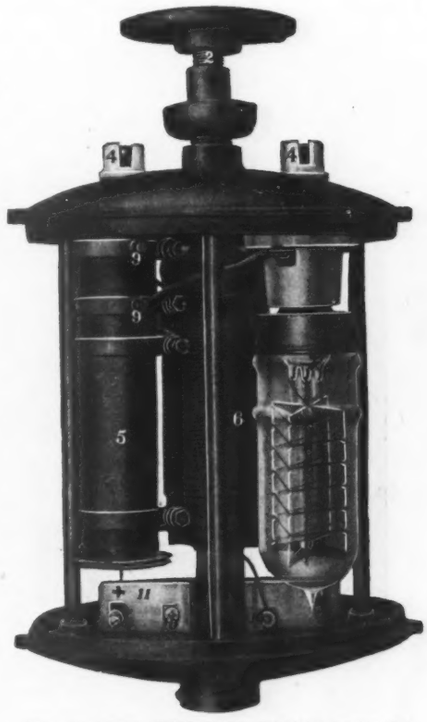


FIG. 1.—1908 MODEL LAMP.

coil compensate for ordinary fluctuations. All standard lamps are made for either 110 or 220-volt circuits and standard series lamps may be operated from 500 to 600-volt circuits. The lamp shown has a small solenoid between the holder and auxiliary, and when the circuit is closed the current flows through the



FIR. 2.—NEW AUXILIARY, CASING REMOVED.

solenoid, which tilts the vapor tube for starting. This type of lamp is particularly suited for installation in such places where it would be difficult to reach the lamp to tilt the vapor tube by hand.

Automatic Pressure Regulator for Direct-Current Motors.

Fig. 1 herewith shows the latest motor-driven pressure regulator brought out by the Automatic Switch Company, of 131 Liberty Street, New York. The regulator is a combination of a motor-driven starter and a magnet switch operated in conjunction with a pressure-controlled pilot switch as shown in Fig. 2. The magnet switch is of the single-pole type; but can be obtained double-pole if desired, and requires energy only during the actual movement to close or open the circuit. The magnet is not subjected therefore to danger from overheating by reason of being continuously supplied with energy. The controlling circuits from the pilot control switch are broken on this main switch, thus obviating arcing at other points of contact, and means are provided on the magnet switch for taking care of any arcing. The contacts of the pressure control pilot switch are of silver and not being called upon to break a circuit carrying much current are not liable to injury due to arcing. The operation of the controller is as follows: The pressure at starting being nil, the pressure regulating gauge arm is in position to close a contact so that energy is supplied to the magnet switch. When this switch is closed, the circuit is made through the starting box to the motor, causing the armature to move and drive the worm shaft shown at the top which revolves the magnet clutch. An armature swung from the stud on which the cup revolves is magnetically clutched to the cup and, turning with it, pulls up the arm of the starting box. The magnet clutch winding is connected in series with a small retaining magnet shown at the top of the resistor segments. When the arm of the starting box comes in contact with the retaining magnet it short-circuits the clutch magnet coil and relieves the worm gear from any work other than the turning of the cup. As soon as the arm has reached its top-most point, a copper contact shown at the left of the retaining magnet bridges the carbon contact on the resistance arm causing the energy to flow through a metallic circuit without additional resistance. The motor will then have reached full speed in a time proportional to the load, the starting box arm having been driven at a speed directly proportional to the speed of the motor, but having a constantly progressing movement across the resistor contacts, thus decreasing the resistance as the motor increases in speed. When the pressure in the tank reaches the desired value the pressure regulating gauge arm will have left the contact by which the original circuit was made and will come in contact with the opposite circuit closing contact, thus opening the circuit to the main

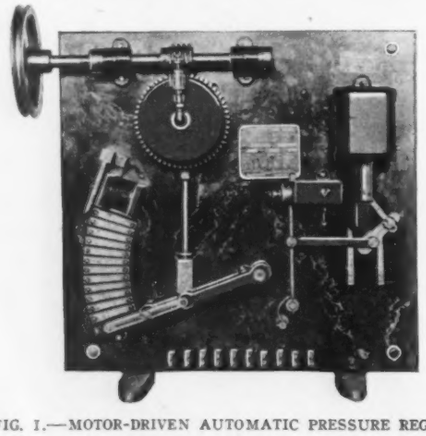


FIG. 1.—MOTOR-DRIVEN AUTOMATIC PRESSURE REGULATOR.

switch and causing the motor to stop. This operation is repeated every time the pressure drops from the predetermined value. As the arm of the starting box is driven by the motor it is starting, an overload on the motor produced by excessive friction or from other causes would prevent its movement across the resistor segments, or at any rate increase the length of time required, thus protecting the motor against the excessive current caused by too quickly short circuiting the starting rheostat. As the starting box arm is driven by a mechanical movement imparted through the magnet clutch, this clutching effect may be far in excess of the amount required without increasing the speed of the starting box arm. Thus it will be seen that this clutching magnet may be wound to work satisfactorily under almost any variation in line

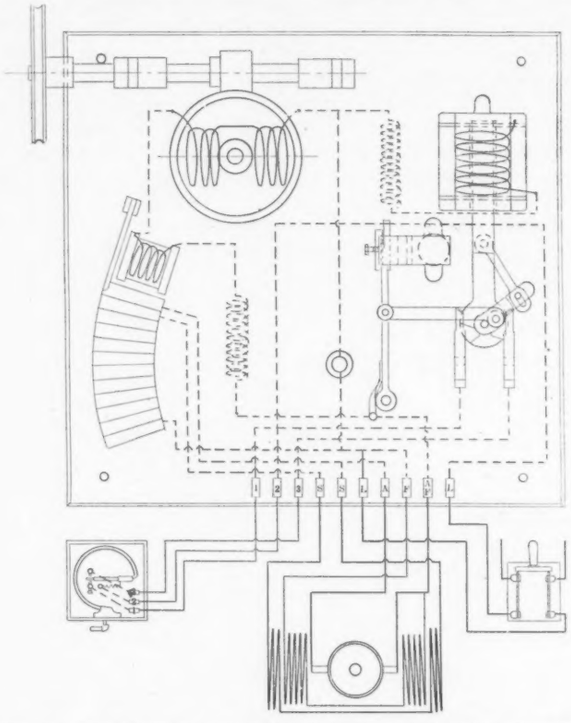


FIG. 2.—CONNECTIONS OF MOTOR-DRIVEN AUTOMATIC PRESSURE REGULATOR.

voltage, and it is especially necessary that such a device should be thus constructed when used in connection with street railway circuits where the voltage varies from 350 to 700 volts, although normally 500 volts.

The Electric Drive in a Hardware Factory.

An interesting example of the application of the induction motor drive is found in the factory of the O. M. Edwards Company, of Syracuse, N. Y. This company is an extensive manufacturer of hardware specialties used in both the steam and electric railroad trade, such as window and extension platform trap door fixtures, steel window sash, moulding, etc. Formerly the company purchased energy from the Syracuse Lighting Company, using 500-volt direct-current motors for driving the wood and metal working machinery, and was so well satisfied with electric motor drive that when the factory was enlarged an isolated alternating current plant was installed together with a complete induction motor equipment.

The generating equipment consists of a Sweet "Straight-Line" engine direct-connected to a 220-volt, 70-kw, 60-cycle, three-phase generator. The generator is of the revolving-field type built by the General Electric Company. A tap is brought out from the neutral point of the generator winding for incandescent lighting purposes.

The motors are of the standard General Electric squirrel-cage type, the total rating installed being a little over 100-hp. The method of drive is what is commonly known as the group drive, and the motors are suspended on platforms from the ceiling. In each machine-room the machines are assembled in four groups, a motor in each corner of room driving separate line shafting from which machines are belt-driven. Starting compensators are placed conveniently near to the motors. The entire electrical equipment has been in operation continuously eleven hours per day for over a year without any operating trouble whatever.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—There was a decided improvement in sentiment throughout the country during the week—the outlook is considered brighter, and commercial loans were made with more freedom than in the recent past. Trade in general was somewhat backward and in some sections the mild weather is a check to the widest activities. Jobbers report trade quiet and merchants disposed to reduce stocks rather than to anticipate requirements. In some lines collections are better than those of last month. Many mills have resumed operation, although in some cases only on part time or part force, but the percentage of idle machinery has perceptibly decreased. Building was quiet; in 1907 expenditure at 60 cities was about 10 per cent lower than that of 1906. Iron and steel production has a more favorable outlook. During the past two months the annual rate of production has declined over 57 per cent, but on the whole production in 1907—over 25,700,000 tons—was the heaviest on record, being 1.5 per cent over the previous best year—1906. At some centers prices are a trifle firmer and the markets are generally easier. Finished lines are dull, and lower prices for light steel rails are looked for. The exports of wheat, including flour, from the United States and Canada for the week ending Jan. 9 aggregated 6,804,273 bushels, against 51,119,394 bushels in the week previous and 4,073,110 bushels in the corresponding week last year. Corn exports of the week were 1,111,874 bushels, against 741,691 in the previous week, and 1,296,187 bushels in the corresponding week of last year. Copper was firmer on European purchases, and a better financial situation, but domestic demand is still light, trade in finished goods being dull. The closing quotations were 13¾c. for Lake, 13⅝c. for electrolytic, and 13⅜c. for casting copper. Business failures during the week showed a large increase, 435 being reported by *Bradstreet's*, against 345 in the previous week, and 223 in the corresponding week of last year.

PLANT FOR PULP MILL.—After installing an electric generating unit and operating a portion of its plant with motor-drive, the Everett Pulp & Paper Company, proprietors of a large mill at Everett, Wash., noted for the quality of its output, recently decided that the economies effected by this system, as well as numerous other advantages, warranted it in putting its entire plant on the same basis. Accordingly the president and general manager of the company, Mr. W. H. Howarth, on his return from an extensive trip abroad, visited the leading industrial centers of the East, accompanied by Mr. T. H. McDonald, his chief engineer, with a view of deciding upon the best type of prime mover to use; and, after observing the operation of various standard machines, particularly in the light of his European experience, Mr. Howarth concluded to purchase a steam turbine, having 500 kilowatts capacity, of the improved type built by Allis-Chalmers Company. The question most thoroughly gone into by Mr. Howarth was that of "reliability," Mr. Howarth having some doubt as to whether the steam turbine could be sufficiently depended upon as a prime mover for the service required in his company's mill. The builder was, however, able to point to a large number of its turbines installed not only in electric railway and lighting plants, but also in industrial works of various kinds, ranging from factories where the load is comparatively uniform and steady to steel mills where it fluctuates widely and with great rapidity during continuous 24-hour operation, and the results demonstrated were such as to leave no doubt in Mr. Howarth's mind as to the dependence to be placed on these units even under the most severe conditions of service.

THE GREAT WESTERN POWER COMPANY, which is installing a large hydro-electric power plant on the Feather River, in California, is one of the few large companies in the country engaged on construction work that has not reduced its force on account of the financial flurry. Under favorable conditions it is expected now that the first development will be completed in July of this year. The transmission line will be run as directly as possible from Island Bar to Oroville. From that city to Sacramento the line will follow the right of way of the Western Pacific Railway. Future development work at Big Bend will depend on circumstances as to the quantity of electric power that can be developed after the machinery now ordered has been put in working condition and the demand for electricity has exceeded 50,000 horse-power. If the demand is good and a sufficient increase of power can be developed at Big Bend, another force of 1000 men or more will be put at work. The Great Western Power Company has another large power development at Butt Valley, on the Feather River, near Prattville. The company is said to own nearly all of Big Meadows about Prattville. A few miles from the latter place it has changed the channel of the Feather River and plans a great storage reservoir for water. The plan is to run a large tunnel through the hill between Big Meadows and Butt Valley. At the lower end of Butt Valley a high dam will be constructed. The company has also purchased the rights and property of the Golden State Power Company along the Feather River between Butt Valley and Big Bend. It is estimated that the Great Western Power Company can develop 200,000 horse-power along the Feather River.

INCORPORATIONS IN 1907.—Records that are apparently complete show a total of 898 industrial and miscellaneous companies formed during the year 1907, with a capital of $500,000 or more, the aggregate capital of which is $1,642,830,000, and 47 railroad companies, whose total reaches $333,100,000, or 945 companies representing a capital of $1,975,930,000. In a similar compilation for 1906 the amount of capital involved was $3,127,745,000 and the number of companies 996. Of the latter 891 were industrial and miscellaneous companies, with a total capital of $2,410,745,000, and 105 railroad companies with $717,000,000 capital. In 1905 the total number of companies formed was 774, with a capital of $1,893,870,100. In 1904 the number of companies was only 407, with a combined capital of $1,055,635,000, while in 1903, the 810 companies formed had $2,422,017,000 capital. The largest incorporation year was 1901, when 1090 companies were chartered with an aggregate capital of $4,333,099,250, while 1899 was second, the combined capital of the companies formed in that year being $4,207,000,000. In 1902 the number of companies formed was 1023, and the amount of capital $3,755,981,400. In 1900 the companies formed had a total capitalization of $2,589,649,000. The period of huge consolidations seems to lie in the past.

THE NORTH MOUNTAIN POWER COMPANY, of Eureka, Cal., has an option on the plants of the Eureka Lighting Company, and, it is reported, will buy them at a price in the neighborhood of $500,000. The North Mountain Power Company was organized several years ago. At the present time it has valuable water rights on the Trinity River and is planning the erection of a large power house there, one greatly exceeding the capacity of the power house at Junction City. A power line stretches from the Trinity River to Eureka, passing through an auxiliary station in the east end of the city. The Eureka Lighting Company is one of the branches of another corporation, headed by President C. O. G. Miller, and owning a large electric plant in Los Angeles. It is the pioneer lighting company in Eureka. There are two stations owned by it in Eureka. For the last two or three years, or since the North Mountain Power Company came into existence, there has been the keenest competition between the Eureka Lighting Company and the North Mountain Company, and it has gone to such a length that neither company has been able to gain much as a result, although the city of Eureka has profited very much in the matter of street light, which the North Mountain Power Company is now furnishing at $2.45 per arc lamp per month.

PLANT FOR RICHMOND, VA.—Following the purchase of a 3250-kw Allis-Chalmers steam turbo-alternator a few months ago, the Virginia Passenger & Power Company, of Richmond, Va., has recently made a further addition to its power plant equipment in the shape of a 750-kw Allis-Chalmers water-wheel type alternator wound for 2300 volts, 60 cycles, three-phase, and designed to operate at 128 r. p. m. This unit will be ready for operation by April 1, 1908.

EXPORTS OF MANUFACTURES.—It is noted that the exports of manufactures from the United States aggregated more than three-quarters of a billion dollars in value in the calendar year 1907. Eleven months' figures supplied by the Bureau of Statistics of the Department of Commerce and Labor show exports of manufactures aggregating over $700,000,000, a monthly average during those 11 months of $64,000,000, thus justifying the statement that the December figures, not yet available, will bring the total for the year above the $750,000,000 line. The manufactures exported in 1907 averaged more than $2,000,000 a day, against less than $1,000,000 a day in 1897. The value of these exports in the single month of June was more than in the entire year in 1870. The share which manufactures form of the total exports in the eleven months of 1907 is 41.7 per cent. Manufactures imported in 1907 aggregated in value about $650,000,000, against approximately $770,000,000 value of manufactures exported, thus indicating that the exportation of manufactures now exceeds the importation of manufactures by about $120,000,000 per annum. Before that time imports of manufactures always exceeded exports.

SUBMARINE SIGNAL.—The Submarine Signal Company, of Boston, has received a check from the United States Government in settlement for the equipment of 23 warships. As the Government never pays royalties, the apparatus is sold outright for a lump sum.

Financial Intelligence.

THE WEEK IN WALL STREET.—There were many sensational advances in the stock list, and dealings in stocks and bonds were the heaviest since the panic. Money rates were easier and the banks are doing business practically on a cash basis, and credit facilities have about entirely recovered. The receivership of the Chicago Great Western Railway had only a temporary individual effect on prices, but Southern Railway receivership rumors weakened the market on Friday. In the initial display of strength, the Hill stocks took the lead with Northern Pacific as a feature, there being strong hopes expressed of an extra dividend. On Wednesday, however, when the directors declared the regular dividend, a reaction occurred in that group. The anthracite coal stocks then came to the front and received strong support. The industrials were active, though the Steel issues showed only a moderate response to the bullish influences, this being accounted for by a variety of unfavorable reports about the volume of current orders. The electric and traction stocks shared the improvement with the general list, and substantial gains were reported all along the line. Some business was transacted in stocks which have been inactive for some time. The curb market was broader, with a revival of trading in the mining group on a scale much larger than in the previous week. In bonds there was a heavy trading, and Allis-Chalmers 5s rose sharply. Following are the closing quotations of Jan. 15:

NEW YORK.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
Allis-Chalmers Co.....	6	6½	General Electric 115		123¼
Allis-Chalmers Co. pfd.	17½	21¾	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	—	Interborough Met. com.	6½	7¼
American Locomotive...	36⅞	41½	Interborough Met. pfd..	18¾	20¾
Amer. Locomotive pfd..	86	90	Mackay Cos.	58	58
American Tel. & Cable..	—	—	Mackay Cos. pfd.....	61	62¾
American Tel. & Tel...101¼		106	Marconi Tel.	—	—
Brooklyn Rapid Transit.	40	43½	Metropolitan St. Ry....	—	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	—	—
Electric Boat pfd.....	—	—	Western Union Tel....	57	58
Electric Vehicle	—	—	Westinghouse com.....	41½	50¾
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	—	—

BOSTON.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
American Tel. & Tel...102		107	Mass. Elec. Ry pfd....	49	50*
Cumberland Telephone..	—	98	Mexican Telephone.....	1¼	1¼
Edison Elec. Illum.....208		212	New England Telep....106		113½
General Electric	—	—	Western Tel. & Tel....	4	5
Mass. Elec. Ry.....	10½	12	West. Tel. & Tel. pfd..	50	62

PHILADELPHIA.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
American Railways.....	43	43	Phila. Electric	5¾	6⅜
Elec. Co. of America...	9½	8⅝	Phila. Rapid Transit....	17⅞	17½
Elec. Storage Battery...	31½	32	Phila. Traction	84	86⅝
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
Chicago City Ry.....150		150	National Carbon	53	50
Commonwealth-Edison ..	78	84	National Carbon pfd...102		103
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.....108		118½	Union Traction pfd....	—	—
Metropolitan Elec. com.	15	17			

*Asked

WESTINGHOUSE PLAN.—The committee in charge of the affairs of the Westinghouse Manufacturing Company will meet the present week to decide upon the plan for reorganizing the company. Although a plan of reorganization has been outlined in general, nothing official will be divulged until after the meeting. According to current reports, a plan has been under discussion which provides for the creation of a first mortgage bond issue of $45,000,000 bearing interest at 5 per cent. In exchange for the $18,500,000 outstanding, convertible 5 per cent gold bonds, $18,500,000 of the new issue will be offered and the remainder of the issue will be used to pay off the floating indebtedness, outstanding short term notes and debenture certificates. The floating indebtedness, according to the reports of certified accountants, is $14,000,000 and it is proposed to fund most of this debt by offering to creditors the new bonds, dollar for dollar, for their claims. Similarly the new bonds will be offered, dollar for dollar, to creditors holding $1,969,000 debenture certificates of the $6,000,000 6 per cent collateral notes due Aug. 1, 1910, and the 5 per cent French loan due Oct. 1, 1917. It is said that George Westinghouse and his associates have agreed to take all or the greater part of $7,000,000 of stock, which is to be sold at par in order to provide working capital for the company. In all there is now outstanding $4,000,000 preferred stock and $24,000,000 assenting stock. The new stock will be of the latter class. The committee that has been in charge of the plan consists of Richard Delafield, president of the National Park Bank; James N. Jarvie, chairman; Albert H. Wiggin, vice-president of the Chase National Bank; Paul M. Warburg, of Kuhn, Loeb & Co.; F. H. Skelding, president of the First National Bank of Pittsburg; Charles A. Moore, of Manning, Maxwell & Moore; Neal Pantoul, of F. S. Moseley & Co., of Boston; and A. G. Becker, of Chicago. The committee is fairly representative of all interests in the company, and the members believe that the plan supplies equitable treatment to creditors, noteholders, bondholders and stockholders.

ELECTRICAL SECURITIES CORPORATION.—The annual report of the Electrical Securities Corporation was issued this week. It shows the following profit and loss account: Bond interest received and accrued, $287,712; other interest, notes, bank deposits, etc., $15,747; dividends on stock, $57,726; total, $361,185; collateral trust bond interest, $146,380; expenses, $47,034; net profit, $167,771; profit from sale of securities, etc., $87,062; total net profit, $254,833; previous surplus, $783,397; total surplus, $1,038,230; preferred dividend, $50,000; balance, $988,230; decrease in book value of assets, $119,341; surplus Nov. 1, 1907, $868,886. The statement of assets and liabilities as of November 1 last follows: Assets.—Underlying securities, $3,000,238; cash to redeem collateral trust 5 per cent bonds, $1,840; surplus brought forward, $251,578; investment securities, $3,017,343; notes and accounts receivable, $368,603; underwritings, $681,250; accrued interest receivable, $109,676; cash, $13,798; total, $7,443,826. Liabilities.—Collateral trust 5 per cent bonds, $2,750,000; surplus of collateral held as security, $251,578; common stock, $2,000,000; preferred stock, $1,000,000; notes payable, $544,526; accrued interest payable, $27,312; reserves, $1,524; net profit since Nov. 1, 1904, $368,886; surplus as of Nov. 1, 1904, $500,000; total, $7,443,826.

DIVIDENDS.—Directors of the Philadelphia Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable Feb. 1. Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent, payable Jan. 31. The Edison Company, of Boston, has declared the regular quarterly dividend of 2½ per cent, payable Feb. 1. Directors of the Omaha Electric Light & Power Company have declared the regular semi-annual dividend of 2½ per cent, payable Feb. 1. Directors of the Manhattan Electrical Supply Company have declared the regular semi-annual dividend of 3 per cent on the preferred stock and a dividend of 4 per cent on the common stock out of the earnings of the past six months, both payable Feb. 3. Rochester, N. Y., Railway & Lighting Co. has declared a dividend of 5 per cent on the common stock, payable Jan. 15. Directors of the Michigan State Telephone Company have declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 1. Directors of the Electric Bond & Share Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Feb. 1.

BELL TELEPHONE BONDS.—Underwriters of the American Telephone 4 per cent convertible bonds are in receipt of a call for the final payment of 10 per cent on account of subscriptions to the bonds, payable Jan. 15, 1908. By the middle of January the full amount of the bonds will be outstanding.

GENERAL NEWS

Construction News.

CORNING, ARK.—George Booster is making preparations to install a lighting plant in Corning. He proposes to purchase the existing plant owned by E. D. Sheeks, and remove it to his stave factory.

EUREKA SPRINGS, ARK.—Henry C. Brent, vice-president of the Kansas City Trust & Fidelity Company, of Kansas City, Mo., has been appointed receiver of the Citizens' Electric Company, which controls the electric lighting plant, the street railway and other important interests in the town. The application for the appointment of a receiver came from the Kansas City Trust & Fidelity Company, which holds $107,000 of the Citizens' Electric Company's bonds, which are the property of the defunct Citizens' Bank.

LAKEPORT, CAL.—George P. Low, general manager of the Lake County Electric Power Company, writes that the company will expend about $100,000 and will install gas engines, extend its electric transmission lines and make extensions to the gas plant. Natural gas will be used for fuel.

LITTLE ROCK, ARK.—George Belding, of Hot Springs, one of the promoters of the proposed Municipal Light Company, states that Atwood Benton, in whose name the company applied for a franchise, is the personal representative of R. G. Weber, secretary and treasurer of the Weber Gas Engine Company, of Kansas City, Mo., who, with George Belding, Mr. Beauchamp and others, is interested in the enterprise.

SPRINGDALE, ARK.—The Springdale Electric Light & Power Company, which was recently granted a franchise, will erect a power plant at a cost of about $8,500. The equipment of the plant will consist of a 65-kw, direct-current generator; 90-hp engine and a boiler of 100 hp.

BERKELEY, CAL.—The San Francisco, Oakland & San José Railway Company, operating the Key route system, has applied for a 50-year franchise to build and operate an electric railway along Sacramento Street from the Oakland line to the north end of Berkeley, and branching through the hill country to the north to the section donated for the proposed site of the state capitol.

COLUSA, CAL.—The Snow Mountain Electric Power Company contemplates calling for bids in the spring for the construction of a hydro-electric power plant at Colusa, the cost of which is estimated at $250,000. The plant will develop about 300 horse-power.

IMPERIAL, CAL.—The City Trustees have passed a resolution to have the streets lighted by electricity. It is understood that the contract for lighting the city will be given to the Holton Power Company.

OAKLAND, CAL.—An entire block of land in East Oakland, at White and Prospect Streets, has been purchased by the Western Power Company, according to deeds recently filed for record. The site will be used for the erection of a sub-station at the end of the high-tension line to be run from the Big Bend plant on the Feather River. A main steam plant auxiliary of 30,000 horse-power is to be erected at Sessions Basin, at the foot of Sixth Avenue.

OROVILLE, CAL.—The Oro Water, Light & Power Company has completed its new power plant at Coal Canyon and installed the machinery. A successful test has been made of the generating equipment. This company now has three power plants within 15 miles of Oroville. The largest one, with an output of 5000 horse-power, is located above Pentz, about 14 miles distant. The second, with about 2000 horse-power is located at Coal Canyon, and the third and the oldest is at Thompson's Flat, about 10 miles from Oroville. The rating of the last is less than 1000 horse-power. The same water runs the water wheels of all three plants.

SAN FRANCISCO, CAL.—The Southern Pacific Company will commence the work of converting the operation of its lines from steam to electricity as soon as the franchise is granted. The first change will be on the line running from Oakland to Berkeley, and will ultimately be extended as far as Niles. The plans for the power house to be located at the estuary shore have been completed and work will commence immediately after granting the franchise in the city.

WILLOWS, CAL.—The Northern California Power Company, which supplies Willows with electricity, through its branch corporation, the Willows Water & Light Company, has reduced the voltage on its main lines, as well as on the Willows line, from 40,000 to 20,000. This reduction has been made to lessen the accidents which have occurred since the wet weather set in. The high voltage will again be placed on the lines next summer.

PUEBLO, COL.—We are informed that the Pueblo & Arkansas Valley Electric Railway Company, which proposes to construct a railway to connect Pueblo, Avondale, Fowler and Rocky Ford, a distance of 53 miles, will commence work on the construction of its road next April. The road will be operated by steam and electricity. Energy for operating the road will be purchased from the Pueblo Traction Company. The capital stock of the company is placed at $300,000 and the officers are: N. Douthitt, Kansas City, Mo., president; M. G. Saunders, of Pueblo, vice-president; F. R. Stoller, Kansas City, Mo., secretary; F. B. Chappege, Kansas City, Mo., treasurer, and N. C. Van Natta, Pueblo, chief engineer. The main office of the company is located at Kansas City, Mo.

WILMINGTON, DEL.—The directors of the Street and Sewer Department have made arrangements with the companies now furnishing both gas and electric lighting for the city to extend the contracts until July 1. The contracts for street lighting expired Jan. 1.

WILMINGTON, DEL.—The directors of the Street and Sewer Department have granted the Delaware Electric Transmission Company permission to bid for the next electric lighting contract on the same basis as the two companies now in business here, which made it necessary for the board to eliminate some of the obligations in the franchise granted to the company some time ago. The conditions that the company desired removed for the present were that the company should furnish energy to the city for 500 or more arc lamps of the same candle-power as those now in use, at the rate of $40 each per year, based on a five-year contract, and to furnish electricity to the city for lamps at two cents per kw-hour, and for other purposes at five cents per kw-hour, the minimum charge for commercial purposes to be 10 cents, with a 10 per cent reduction for cash. When the above proposition was submitted to the city the company expected to secure electricity from the Susquehanna Power Company's plant to be erected on the Susquehanna River, but owing to litigations, etc., it has not yet been able to begin the construction of its plant, and the Delaware electric company claims it will be impossible to generate electricity with coal or gas at the rates quoted.

TAMPA, FLA.—The Tampa Electric Company is contemplating making extensive improvements to its power plant, and will purchase a dynamo and other electric equipment. G. W. Wells is manager.

ALBANY, GA.—It is understood that plans and specifications have been prepared by J. E. Sirrine, of Greenville, S. C., for the Albany Power & Manufacturing Company for its proposed water power development and hydro-electric plant, the cost of which is estimated at $1,000,000. It is proposed to construct a plant of about 10,000 horse-power.

AUGUSTA, GA.—The Atlanta & Carolina Construction Company has applied to the City Council for permission to construct an electric railway and erect terminal stations in the city of Augusta. The company proposes to construct an electric railway between Augusta and Atlanta.

EDGEWOOD, GA.—The new municipal electric light plant has been completed and was started Dec. 28. Over 40 arc lamps and 60 incandescent lamps have been placed on the streets.

LAFAYETTE, GA.—The city will soon vote on the proposition of issuing $10,000 in bonds for the construction of an electric light plant.

MACON, GA.—The Macon Railway & Light Company is contemplating extensive improvements at its power house, including the installation of a 1000-kw generator to furnish electricity for lamps.

NAMPA, IDAHO.—The Oregon Short Line Railway is said to be considering the proposition of establishing an electric light plant.

SALMON, IDAHO.—Plans have been perfected for incorporating the Andrews Light & Power Company with a capital stock of $50,000. The power house will be located on Charles Street.

SALMON, IDAHO.—We are informed that Messrs. Quarles & Quarles, owners of the local electric light plant, contemplate installing a new 120-kw, three-phase, 60-cycle alternator in their plant.

BARRY, ILL.—The power house of the Barry Electric Light & Power Company is reported to have been destroyed by fire.

CARBONDALE, ILL.—The capital stock of the Farmers' League & Community Telephone Company has been increased from $5,000 to $10,000.

DECATUR, ILL.—It is reported that the municipal electric light plant is to be enlarged. E. S. McDonald is mayor.

MURPHYSBORO, ILL.—The Murphysboro Water Works, Electric & Gas Light Company is contemplating installing a 500-kw, alternating-current, 2200-volt, two-phase direct-connected unit. W. O. Settle is manager.

CRAWFORDSVILLE, IND.—At a recent meeting of the City Council an appraisement of the municipal electric plant was ordered and a committee has placed the valuation at $57,632. The appraisement was ordered with a view of selling the plant to a New York corporation which has made an offer of $46,000 for it. No action has been taken as yet by the City Council.

KNIGHTSTOWN, IND.—Charles F. Baxter, town clerk, writes with regard to the proposed improvements to the municipal electric light plant, for which the citizens recently voted to issue $12,000 in bonds, that the generator, turbine and boilers have been purchased, but a condenser is yet to be purchased.

NEW ALBANY, IND.—The City Council has appointed a committee to prepare a new franchise ordinance for lighting the streets with a provision to sell the franchise to the highest bidder. The street lighting franchise of the United Gas & Electric Company will expire Sept. 1.

ROCKPORT, IND.—The City Council has granted a ten-year franchise to the Rockport Water Works & Electric Light Company to light the streets and to supply the inhabitants with electricity for lamps and motors and with water.

LINDSBORG, KAN.—The installation of an additional generator in the municipal electric light plant is under consideration. M. H. Blaine is manager.

TOPEKA, KAN.—The City Council has decided to submit the proposition to issue $50,000 in bonds for the enlargement of the municipal electric light plant to the voters at the coming spring election.

MAYFIELD, KY.—The Southern Electric Railway Company has filed a deed of trust to the Windsor Trust Company for a loan of $2,000,000, with which it is proposed to construct the new electric railway between Maysfield and Paducah.

SOMERSET, KY.—O. H. Waddle and W. C. Roberts, stockholders in the Somerset Water, Light & Traction Company, have filed suit in the Pulaski circuit court, asking that a receiver be appointed for the company, and that Dr. W. Godfrey Hunter be removed as manager. They allege that the franchise has been endangered by the present management, as the City Council is not satisfied with the manner in which the affairs of the company have been conducted.

NEW IBERIA, LA.—The City Council on January 6 awarded the contract for the new boilers for the municipal electric light and water works plant to Lawrence W. Ewing, for $2,394.

SLIDELL, LA.—The Slidell Light & Electric Company is planning to commence work on the construction of its new plant in the near future.

BANGOR, ME.—A bill was filed Jan. 4 foreclosing the mortgage on the Bodwell Power Company, and the appointment of a receiver was asked for by the Central Trust Company, of New York, N. Y., the trustee under the mortgage. The company has been obliged to default the January interest on its $1,000,000 first mortgage bonds. It is said that the present troubles are due to the refusal of one of its chief customers, a paper pulp concern, to pay an overdue bill for power.

GREENVILLE, ME.—The Greenville Light & Power Company is contemplating extending its transmission lines to Monson and Guilford. Harry L. Sawyer is manager.

HOULTON, ME.—The Bangor & Aroostook Railroad Company has recently installed an electric light plant at its station in this town to furnish electrical energy for lighting its shops and offices.

KENNEBUNKPORT, ME.—The Atlantic Shore Line Railway will soon install an electric lighting system for lighting the streets and residences in Kittery, Eliot and Sanford. Electrical energy for operating the systems will be supplied from the company's power houses at Kittery Point, Dover and Sanford.

LUBEC, ME.—The electric light plant was closed down Dec. 21 for an indefinite period. It is said that the Drew Machinery Company, which owned and operated the plant, will not continue the service and that a local company will be formed, and as soon as possible will equip the plant with new machinery and make other necessary improvements. R. J. Peacock is interested in the project.

MONSON, ME.—Ernest D. Blaisdell, of Dexter, has been awarded the contract for the installation of the electric light plant for the Monson Light & Power Company.

NORTH ANSON, ME.—The Carrabassett Stock Farms Company is installing a 100-kw dynamo to furnish electricity to light the town.

NORTHPORT, ME.—Some of the summer residences of this town are making arrangements to have the Belfast Gas & Electric Company, of Belfast, extend its electric lighting system to Northport next spring. As soon as the company submits prices a canvass will be made among the cottage holders.

EASTON, MD.—Martin M. Higgins, Mayor, writes that the question of constructing a municipal electric light plant will shortly be submitted to a vote unless in the meantime the city is able to procure parties to take a franchise for an electric light, heat and power plant. This franchise, if given, would include a contract for lighting the town for a number of years. The lighting commission, of which L. W. Trail is chairman, has recommended that the town be bonded for the construction of a municipal electric light plant.

ASHBURNHAM, MASS.—The new electric lighting system has been completed and was started Jan. 2. Electrical energy for operating the system is furnished by the Gardner Electric Light Company at the rate of four cents per kw-hour at the switchboard. By the terms of the contract the company is to supply electricity to the town for a term of ten years, the contract providing for a readjustment of prices at the end of five years, at the request of either party.

CHICOPEE, MASS.—The Electric Light Commissioners have awarded the contract for the new arc lighting system to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for $9,985.

CHICOPEE, MASS.—The J. Stevens Arms & Tool Company is making arrangements to install a 50-hp direct connected generating unit to furnish electricity for lighting its plant. The electrical machinery will be furnished by the Westinghouse Electric & Manufacturing Company. The municipal electric light plant now furnishes lighting service for the company at a cost of $50 per month.

GREENFIELD, MASS.—The Connecticut River Power Company, which is constructing a large dam between Vernon, Vt., and Hinsdale, N. H., proposes to erect within the next two or three years, or after the completion of the Vernon dam, a low dam at the head of the French King Rapids, a short distance above Turners Falls. The purpose of this dam is to develop power to generate electrical energy during the periods of low water. The dam will be a movable structure, and will be so arranged that in times of low water it can be raised to its full height of 10 or 12 feet and in times of high water lowered to the bed of the stream.

HOLYOKE, MASS.—An announcement has been made by the municipal gas and electric lighting department that the price of electricity will be reduced from 10 cents to 6 cents per kw-hour. The new rate will go into effect Feb. 1. During the past year the price of energy for street lamps has been reduced from $80 to $60 per lamp per year.

LEICESTER, MASS.—An order of notice, returnable on the first Monday in March, has been issued by the superior court on the petition of the Rawson Light & Power Company, of Leicester, for dissolution of its corporation. The petition states that the company has ceased to do business, has no debts and has disposed of all of its property. The company was incorporated in 1896 with a capital of $25,000.

LYNN, MASS.—The Lynn Gas & Electric Company has petitioned the State Gas and Electric Light Commissioners for authority to issue $195,000 additional capital stock.

MIDDLEBORO, MASS.—The managers of the municipal electric light plant contemplate establishing a day service for lamps and motors in the near future. George A. Philbrook is manager.

NEEDHAM, MASS.—It is reported that the town committee is contemplating selling the municipal electric light plant to the Edison Electric Illuminating Company, of Boston, providing a satisfactory contract can be made with the company to supply electricity for lighting the town.

NORTHAMPTON, MASS.—The Northampton Street Railway Company has petitioned the Railroad Commissioners for authority to issue $200,000 additional capital stock, the proceeds to be used in taking up floating indebtedness.

ROACHDALE, MASS.—The Worcester Electric Light Company is making improvements to its system in this place. The old transformers in the sub-station are being replaced with larger ones and the voltage increased from 1000 to 2000. When the improvements are completed 24-hour service will be established. It is said that the company contemplates a thorough overhauling of its lines next summer.

DETROIT, MICH.—The City Council on Jan. 7 passed an ordinance requiring all electric wires, except trolley wires, within a half-mile circle from the city hall to be placed in underground conduits before Jan. 1, 1909.

CALUMET, MICH.—It is reported that the Calumet & Lac La Belle Traction & Power Company will commence work about the middle of this month on the construction of its proposed line between Calumet and Mohawk. Sidney M. Weil is the financial agent. The company also proposes to furnish electricity to mines in Keweenaw and Houghton counties.

GRASS LAKE, MICH.—The directors of the Farmers' Telephone Company have voted to amend its articles of association changing the name of the corporation to that of Home Telephone Company and increasing the capital stock from $10,000 to $50,000.

ISHPEMING, MICH.—The Marquette County Gas & Electric Company has completed its new boiler house and installed the following equipment in the power house: one 500-kw vertical Curtis turbine; one 200-kw Buffalo Forge engine direct-connected to a 110-kw, direct-current, 550-volt street railway generator, also a new storage battery. The company has in view the construction of about two and one-half miles of new track, and is in the market for a double truck closed car.

OWOSSO, MICH.—At a meeting of the Owosso Light & Power Company the following named officers were elected: E. M. Hopkins, of Detroit, president; Charles W. Gale, vice-president; Frank Westcott, of Owosso, secretary and treasurer. The company announces that it will construct a dam 24 feet high and 800 feet long at a natural reservoir on the Shiawassee River, two and one-half miles north of the city. The plant will furnish electrical energy to operate the proposed Grand Rapids-Pontiac electric railway, and for lamps and motors in Owosso.

EVANSVILLE, MINN.—C. W. Webb is endeavoring to secure a franchise for an electric light plant in the town.

MANTORVILLE, MINN.—C. S. Wedge & Son, owners of the local electric light plant, are contemplating installing a new dynamo in their plant.

NEVADA, MO.—We are informed that the Missouri Water, Light & Traction Company will place contracts within a few weeks for the installation of the following equipment: Two 225-hp water tube boilers; 600-hp exhaust steam heater; 600-hp live steam water purifier and the necessary piping. Hiram Phillips is receiver for the company.

ST. LOUIS, MO.—It is reported that A. C. Einstein, president of the Union Electric Light & Power Company, will make application to the county court for an extension of the franchise of the company to cover the entire county.

SLATER, MO.—The municipal electric light plant will probably be rebuilt to increase the output, and a compressed air outfit for pumping installed. L. E. Shepherd is manager.

CHINOOK, MONT.—All bids received for the construction of an electric light plant were rejected and new bids will be called for. John C. Duff is town clerk.

CENTRAL CITY, NEB.—H. Forest, of Central City, has been granted a franchise to establish an electric light system.

COLUMBUS, NEB.—John W. Early, of Lincoln, Neb., consulting engineer, has been engaged by this city to attend to the technicalities of granting a 20-year electric franchise, and for making plans for remodeling the city pumping station, so as to operate the pumps by electricity. John T. Burke, of Omaha, represents the company, which has applied for a franchise.

WAYNE, NEB.—The managers of the municipal electric light department are contemplating establishing a day service in the spring. H. A. Moler is manager.

DOVER, N. H.—The City Council has voted to enter into a five-year contract with the Twin State Gas & Electric Company for the lighting of the city, said contract to cover all-night service.

ASBURY PARK, N. J.—Mayor T. Frank Appleby, in his annual message, recommends street improvements, the placing of telephone and telegraph wires underground and other improvements.

NEWARK, N. J.—In his annual report submitted to the Board of Freeholders, County Supervisor John F. Otterbein, suggested that an electric light plant be installed at the court house to be owned and operated by the county. At present the building is lighted by the Public Service Corporation of New Jersey, under a contract which will expire Sept. 1, 1908. The price for this service ranges from $509 to $1,040 per month.

PLAINFIELD, N. J.—The Public Service Corporation has submitted a proposition to the Council for lighting the streets of the city. The company agrees to furnish the city with incandescent lamps of 25 cp for $15 per lamp per year, and arc lamps up to 50 for $85 per year per lamp, and over 50 at $80. The company agrees to make a five year contract for arc lamps and a three year contract for incandescent lamps.

LAS VEGAS, NEV.—The Consolidated Light & Telephone Company has been granted permission to erect and operate an electric light plant in the town.

AUBURN, N. Y.—The Board of Supervisors of Cayuga County has accepted the proposal of the Auburn Light, Heat & Power Company for lighting the county building. The company has agreed to reduce its previous bid of $1,700 to $1,300, provided the county makes a contract for two years. By the terms of the contract the cost of lighting the building is not to exceed $1,300, and if the meter records show the amount of electricity used costs less than $1,300 the price will be fixed accordingly.

FLUSHING, N. Y.—The New York & New Jersey Telephone Company has planned extensive improvements to its service in the town of Flushing, and work has commenced on the construction of a trunk line from the Flushing central office to Douglaston for the purpose of connecting that section with the Flushing office.

HUDSON, N. Y.—The Common Council on Jan. 6 appointed a committee to make arrangements with the Albany & Hudson Railway Company for the temporary lighting of the streets and public buildings of the city until a permanent contract may be secured. The committee will also look into the question of installing a municipal lighting plant.

LIMA, N. Y.—The Lima-Honeoye Electric Light & Railroad Company is planning to place contracts during the next three months for the construction of about 36 miles of track. It will also purchase gas engines and other equipment for a new power station. Natural gas will be used for fuel.

PATCHOGUE, N. Y.—The control of the Patchogue Electric Light Company has been purchased by a syndicate composed of local citizens. The new owners propose to install new machinery, duplicating the plant and establishing a day service. Eugene Hawkins, president of the Ogdensburg Gas & Electric Company, is to be president of the new company.

VALLEY STREAM, N. Y.—At a meeting of the citizens, held Jan. 10, a committee was appointed to investigate the question of establishing a water and light district and report at the next meeting to be held Jan. 22. The members of the committee are: Christopher Schreiber, Joseph T. Hall and Henry Hendrickson.

WATERVILLE, N. Y.—Walter Bishop, of this village, has purchased a controlling interest in the Waterville Telephone Company. The officers of the company are: I. D. Brainard, president; S. S. Bissell, vice-president; H. M. King, secretary; Walter Bishop, treasurer, and Parks Terry, general manager.

FAYETTEVILLE, N. C.—The hydro-electric plant of the Cape Fear Electric Company, at Buckhorn Falls, has been started, and connections are being made from the sub-station with the electric service in this city. The plant will soon furnish electrical energy for operating the electric light plant, manufacturing plants, etc., in this city. The transmission line from Buckhorn Falls to Fayetteville is 32 miles long. The plant now generates 4000 horse-power and cost about $500,000.

SALISBURY, N. C.—The Salisbury & Spencer Railway Company is planning to construct a sub-station for which contracts will be placed during the next two months. Three 1000-kw transformers will be installed.

SALISBURY, N. C.—It is said that everything is in readiness to resume operations on the large power plant under construction at this place by the Whitney Reduction Company, of Pittsburg, Pa. It is announced that the electric plant with an output of 45,000 horse-power will be ready for service by March 1. A. J. Gillespie, of Pittsburg, Pa., has the contract for the work.

DRAKE, N. D.—The Northwestern Telephone Company has been granted a franchise over the county roads.

ALLIANCE, OHIO.—The Alliance Gas & Power Company is installing a 700-hp Babcock & Wilcox boiler in its plant. D. W. Low is manager.

COLUMBIANA, OHIO.—The Columbiana Water & Electric Light Company will install a 150-hp boiler in its plant this coming summer and may also install a new engine and generator. F. H. Grove is secretary and manager.

CONNEAUT, OHIO.—It is reported that the Meadville & Conneaut Lake Traction Company contemplates extending its lines from Linesville to Greenville, and from Linesville to Conneaut.

ELYRIA, OHIO.—The Elyria Southern Railway Company will commence the construction of its road this spring, which will connect the following cities: Elyria, La Grange, Spencer, West Salem, Ashland, Mansfield and Columbus. The company plans to install the overhead trolley system, electrical energy to be supplied from a power station which is to be erected at Elyria. The officers of the company are: Sumner B. Day, president; W. E. Elliott, vice-president and general manager; W. E. Moser, secretary, all of Elyria; J. M. Starr, of La Grange, treasurer, and G. A. Lagron, of Elyria, engineer.

HAMILTON, OHIO.—It is reported that the Cincinnati Northern Traction Company will install a local electric railway system in Middletown.

MANSFIELD, OHIO.—We are informed that the Roberts-Abbott Engineering Company, of Cleveland, has been engaged as engineer to have charge of the proposed improvements contemplated by the Mansfield Railway, Light & Power Company.

NEW BREMEN, OHIO.—The electric light plant of the New Bremen Electric Light Company has been purchased by the village for $14,000. The village recently issued $20,000 in bonds to purchase and rebuild the plant.

ROCKY RIVER, OHIO.—The village has been in darkness for several nights, owing to the Village Government and the Cleveland Electric Illuminating Company having failed to agree upon rates for a new contract. The mayor and other officials were unwilling to treat with the company on any proposition that the company thought fair, so when the contract expired the service was stopped.

PERKINS, OKLA.—The citizens are considering the question of calling an election to vote on the proposition of issuing bonds for the purpose of purchasing an electric light plant.

SALLISAW, OKLA.—W. W. Ray, secretary and treasurer of the Southwestern Light & Power Company, writes that the company has awarded all contracts for the equipment of its plant.

EUGENE, ORE.—Announcement has been made that the Eugene & Eastern Railway Company will resume work on the construction of the electric line between Eugene and Springfield this month.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until Feb. 6, for power plant, consisting of boiler-room equipment, including boilers, boiler feed pumps, fuel economizer, smokestack, etc; engine-room equipment, including generators, condensers, vacuum pumps, circulating pumps, piping, electric crane, exciters, rotary converters, transformers, lightning arresters, switchboards, regulators, station voltmeter, portable instruments, etc. Blanks and general information relating to this circular No. 415 may be obtained at the office of the Isthmian Canal Commission, Washington, D. C., or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, La.; also from U. S. engineer officers in the following cities: Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Chicago, Ill.; Cincinnati, Ohio; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala.

CHAMBERSBURG, PA.—It is reported that the Chambersburg, Greencastle & Waynesboro Electric Railway Company contemplates making a proposition to the Town Council to install a 300-kw generator in the municipal electric light plant at its own expense, and pay a certain sum to the borough for a supply of energy to operate the railway extension from Greencastle to Chambersburg.

EASTON, PA.—The merger of the Easton Transit Company, the Easton & Bethlehem Transit, the Easton, Palmer & Bethlehem and the Northampton Central Traction Companies has been approved by Governor Stuart. The four companies have been consolidated under the name of the Easton Transit Company with a capital stock of $2,000,000.

LANCASTER, PA.—The Lancaster & York Furnace Street Railway Company has increased its bonded indebtedness from nothing to $150,000, and has also reduced its capital stock from $280,000 to $170,000.

ROYER, PA.—It is reported that the Morrison Coal, Electric Light & Power Company will soon let contracts for the installation of an electric power plant. The cost of the work is estimated at $45,000. For further information address Frank W. Moore, Indiana, Pa.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has decided to increase the equipment in the Waynesboro plant to provide electrical energy for the extension of the electric railway from Greencastle to Chambersburg. Joseph F. Geiser is superintendent.

WEST CHESTER, PA.—The Chester County Power Company has purchased another water power on Elk Creek for the purpose of having additional reserve power when needed.

WEST WHITELAND, PA.—P. M. Sharpless has acquired a water power in West Whiteland township, for the purpose of generating electricity for lamps and motors at his villa in West Goshen.

PAWTUCKET, R. I.—The Pawtucket Gas Company and Pawtucket Electric Company, of this city, and the Woonsocket Electric Machine & Power Company and the Woonsocket Gas Company, of Woonsocket, have been merged, and are in the control of a new syndicate composed of Col. Lyman A. Goff, Darius L. Goff and Frank A. Sayles, of this city; Estabrook & Company and the Stone & Webster Company, of Boston, Mass.

EDGELEY, S. D.—H. C. Tibbetts, village clerk, writes that the citizens on Jan. 6 voted to issue $3,000 in bonds to purchase dynamos and wire for the municipal electric light plant.

LEAD, S. D.—F. P. Hooper contemplates establishing a light plant in the town.

COVINGTON, TENN.—The Memphis, Covington & Northern Railroad Company has been granted a 50-year franchise to operate an electric railway between a point on the southern boundary of the town of Covington and the southern boundary of the county of Tipton.

ATLANTA, TEX.—J. T. Chamblee & Company, owners of the local electric plant, are contemplating establishing a fan service. H. P. Phipps is manager.

DALLAS, TEX.—L. Fulton has filed an application for a franchise to build and operate a street railway in Oak Cliff. The proposed line will be about three miles long.

ENNIS, TEX.—The Ennis Ice, Light & Power Company is contemplating installing a producer gas plant. A. D. Brown is manager.

FORT WORTH, TEX.—The Corron Electric Company, of St. Louis, Mo., has secured the contract for wiring and conduits for the U. S. post office building at Fort Worth for $1,664.

SHERMAN, TEX.—The capital stock of the North Texas Telephone Company has been increased from $40,000 to $52,000.

CASTLETON, VT.—The citizens have voted to make a contract with the Rutland Street Railway, Light & Power Company to light the streets of Castleton by electricity after Feb. 1.

CHRISTIANSBURG, VA.—The municipal electric light plant has been purchased by John L. Vaughan, of Shawsville, and associates. It is understood that a company will be organized to operate the plant.

DANVILLE, VA.—Frank Talbot, superintendent of the municipal electric light plant, writes that it is proposed to enlarge the plant.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company is installing three submarine cables from its new power house in Norfolk to the sub-station in Portsmouth to supply electrical energy in Portsmouth.

PETERSBURG, VA.—The City Council, on Jan. 7, accepted the contract with the Virginia Passenger & Power Company for lighting the streets of the city for a term of five years, at a cost of $57 per lamp per year.

SHEPHERDSTOWN, W. VA.—The Shepherdstown Electric Light & Power Company is reported to have purchased the municipal electric light and power plant. It is stated that no improvements will be made at present, but the company contemplates using power from a hydro-electric plant now under construction near Shepherdstown. John L. Livers is president and treasurer.

BERLIN, WIS.—The Berlin Lighting, Heating & Power Company is planning to install new boilers, stokers, heaters, pumps, etc., in its plant. O. C. Irwin is receiver.

CASHTON, WIS.—An election will be held Jan. 21 to vote on the proposition of issuing $15,000 in bonds for the purpose of establishing a municipal electric light plant.

CORLISS, WIS.—The construction of a combined water works system and electric light plant for this place is under consideration.

DOLDGEVILLE, WIS.—The City Council is considering the proposition of purchasing the present electric lighting plant or constructing an entirely new plant.

LOYAL, WIS.—An election will probably soon be held to vote on the proposition of issuing $17,000 in bonds for an electric light plant and water works system. W. G. Kirchoffer, of Madison, is engineer.

MEDFORD, WIS.—The city has recently voted in favor of issuing bonds for establishing a municipal water works system, and many of the citizens are in favor of purchasing the electric light plant owned by the Medford Light & Heat Company and consolidating the water and light plants to be operated by the municipality.

MILWAUKEE, WIS.—Contracts have been awarded by the Continental Realty Company for the building and machinery for its power plant, to be erected on Commerce Street. Kirchoff & Rose are the architects.

PLYMOUTH, WIS.—The citizens are contemplating increasing the equipment of the municipal electric light plant by the installation of a larger generator. A 200-hp engine has recently been installed and a day service established. P. J. Douglass is superintendent.

PRESCOTT, WIS.—Owing to the increase in the demand for electricity the Prescott electric plant is unable to meet the demands made upon it, and a dam is being erected on the Kinnickinic River at Clifton to develop power to increase the output of the plant.

CALGARY, ALB.—The City Council has entered into an agreement with the Calgary Power & Transmission Company, whereby the company is to furnish all the electricity required by the municipality for a term of five years.

EDMONTON, ALB.—R. R. Kelly, city engineer, writes that the city is about to install a new power station and will erect six miles of transmission lines to be operated at 10,000 volts, three-phase, 60-cycle, and will require all line material, including switchboard at sub-station. The city engineer will be glad to hear from all manufacturers of that class of equipment.

VANCOUVER, B. C.—The Canadian Pacific Railroad has discarded the steam plant for its shops in Vancouver and is now operating the machinery by electricity, which is supplied by the British Columbia Electric Railway Company.

NEW WESTMINSTER, B. C.—S. A. Crawley, of this city, has made application for water rights in behalf of the International Power Company.

MINNEDOSA, MAN.—The Minnedosa Power Company has been granted permission to construct a dam across the Little Saskatchewan River at the outlet at Clear Lake for the purpose of maintaining the high-water mark and supplying Minnedosa with electricity for lamps and motors.

BERLIN, ONT.—At the election held Jan. 6 the citizens voted in favor of issuing $30,000 in bonds to extend the electric light plant and street railway system.

GALT, ONT.—The citizens on Jan. 6 voted in favor of constructing a distributing plant at a probable cost of $27,000; electrical energy to be supplied by the Hydro-Electric Power Commission.

HAMILTON, ONT.—The citizens on Jan. 6 voted to issue $225,000 in bonds for the construction of an electric distributing system in connection to the project of the Hydro-Electric Power Commission.

INGERSOLL, ONT.—The citizens on Jan. 6 voted against the proposition to issue $50,000 in bonds for the purpose of the Ingersoll Electric Light & Power Company, to be used to distribute electrical energy from Niagara Falls in connection with the project of the Hydro-Electric Power Commission.

KENORA, ONT.—It is reported that the town and the Maple Leaf Flour Mills Company have petitioned the Provincial Government for permission to borrow $75,000 to complete the power development scheme. For this projcet $300,000 in bonds have already been issued. Confirmation of an agreement between the town and the company in regard to power is desired.

LISTOWELL, ONT.—This city has applied to the Provincial Legislature to pass a bill which will empower the city to issue $25,000 in bonds to construct and operate an electric light and power plant. It is proposed to supply electricity for street lighting and for domestic and commercial purposes.

ST. THOMAS, ONT.—The citizens on Jan. 6 voted to construct an electric distributing plant to cost about $42,493, to distribute electrical energy from Niagara Falls in connection with the project of the Hydro-Electric Power Commission.

TORONTO, ONT.—The citizens on Jan 1 voted to issue bonds to the amount of $2,750,000 for a plant to distribute electrical energy to be supplied by the Hydro-Electric Power Commission from Niagara Falls.

TORONTO, ONT.—The following cities voted on Jan. 6 in favor of constructing plants to distribute electrical energy to be supplied by the Hydro-Electric Power Commission from Niagara Falls: London, Brantford, Stratford, Guelph, Hespeler, St. Marys and New Hamburg.

MONTREAL, QUE.—The civic fire and light committee have recommended to the Council the acceptance of the tender of the Roberts syndicate to supply electricity for lamps and motors for municipal and domestic purposes for a period of 10 years. Under the tender arc lamps on wooden poles will cost $55 per year, on ornamental poles $57.50 per year, incandescent lamps 10 cents per kw-hour with a discount of 5 per cent on one year contracts and over, and a discount of 10 per cent on 10 year contracts.

MONTREAL, QUE.—A syndicate of European capitalists have subscribed $10,000,000 to be expended on developing water powers and building rural electric street railways around this city. For further information address Rudolph Forget.

QUEBEC, QUE.—The Quebec Railway, Light & Power Company, the Jacques Cartier Electric Light & Power Company, the Frontenac Gas Company, the Canadian Electric Light Company, and the Quebec-Charlevoix Electric Railway Company, with a combined capital of $10,000,000, have amalgamated. It is said that the consolidated company will be capitalized at $20,000,000.

ST. PAUL (BOULEVARD), QUE.—L. J. Marchand, owner of the local electric light plant contemplates adding a 150-kw generator direct connected to a vertical condensing engine to his plant.

REGINA, SASK.—An issue of $425,000 in debentures has been authorized for electric lighting, sewerage and water works. The managers of the municipal electric light plant are contemplating installing an additional generator during the year. E. W. Bull is manager.

SASKATOON, SASK.—The citizens are considering the question of installing an additional engine and 100-kw generator in the municipal electric light plant. E. L. White is manager.

Company Elections.

RED BLUFF, CAL.—At the annual meeting of the stockholders of the Pacific Power Company, held Dec. 10, the following named officers were elected: Dr. A. P. Tartar, president; A. A. Martin, vice-president and manager; Geo. C. Garrett, J. J. Wells and T. D. Goodwin, directors, and D. D. Dodson, secretary.

BALTIMORE, MD.—At a meeting of the directors of the Washington, Baltimore & Annapolis Electric Railway Company, held recently, the following named officers were elected: George T. Bishop, president; John Sherwin, first vice-president; J. N. Shannahan, second vice-president and general manager; W. A. Kappler, secretary and assistant treasurer; J. N. Shannahan, treasurer and assistant secretary.

SPRINGFIELD, MASS.—At the annual meeting of the Springfield Street Railway Company, held Jan. 8, the following named officers were elected: L. S. Storrs, president; Henry C. Page, vice-president and manager; L. Candee, of Boston, treasurer; J. T. Harmer, clerk and controller.

GRAND RAPIDS, MICH.—At the annual meeting of the Cadillac Water & Light Company, held in this city recently, the following officers were elected: William H. Anderson, president; Edward Fitzgerald, vice-president; L. H. Withey, treasurer; M. V. Gerrish, secretary; George Westover, manager. Improvements are contemplated during the new year.

NASHVILLE, MO.—At the annual meeting of the Nashville Telephone Company held recently the following-named officers were elected: Lafayette Scott, president; Riley Halley, secretary, and Julius Ehlers, treasurer.

STAFFORD, VA.—At the annual meeting of the Toluca & Fredericksburg Telephone Company, held recently, the following named officers were elected: Hugh Adie, president; C. A. Bryan, secretary, and E. S. Moore, business manager.

DAGGETT, WIS.—At a recent meeting of the Daggett-Nathan Telephone Company, the following officers were elected: Paul Perrizo, president; Eugene Houte, vice-president; C. W. Wilkins, secretary, and Dr. Landsborough, treasurer.

New Industrial Companies.

THE AMERICAN NATIONAL ASSOCIATION, of Indianapolis, Ind., capitalized at $50,000, has filed articles of incorporation with the Secretary of State. The object of the company is to promote, finance, construct, equip, rent and operate street and interurban railroads, and plants for generating and distribution of electricity for light, heat and power purposes in connection with such roads, and also to engage in electrical, mechanical and structural engineering. C. H. Wilson, C. W. Van Cleve and F. S. Hines are the directors.

THE COMMONWEALTH ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $1,000 by H. J. Dunbaugh, J. E. Wing and G. C. Madison. The company proposes to manufacture electrical apparatus, etc.

THE MULTI-STAGE ROTARY ENGINE COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $50,000. The directors are: Bertram F. Hoffman, Edward A. Piall and Le Grand Hoffman, all of Buffalo, N. Y.

THE STANDARD TELEPHONE MANUFACTURING COMPANY, of Portsmouth, Ohio, has been incorporated with a capital stock of $50,000 by Eugene Knox and others.

THE TRIPLEX TELEPHONE MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by Abraham B. Cox, Harry W. Hillhouse, of New York, N. Y.; Robert E. Bond, of Montclair, N. J.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Toulumne Water Power Company, which is capitalized at $1,000,000. The directors are: Warren Gregory, George H. Whipple, Winfield Dorn, J. S. Lamson and H. H. Rolfe. The purposes of the company are to conduct a general water power and lighting business.

TRINIDAD, COL.—The Southern Colorado Power & Railway Company has been incorporated with a capital stock of $1,500,000 by W. F. Schuyler, K. C. Schuyler, C. Spiess, L. C. Duncan and Frank McLaughlin. The company proposes to supply electricity to the cities and mines in Las Animas and Huerfano counties. The gas and electric light plants and street railway system at Trinidad have been purchased by the new company. The main plants of the company will be established at Trinidad and at Walsenburg. At first the company will operate only in those two counties, but later it expects to extend its system, eventually going into New Mexico. The principal office of the company will be in Denver.

FAIRMOUNT, IA.—The Watson Company has been incorporated with a capital stock of $180,000 by S. L. Watson and others. The company proposes to build and operate electric light and gas plants.

PINCONNING, MICH.—The Pinconning Light & Power Company has been incorporated with a capital stock of $10,000.

SEDALIA, MO.—The Queen City Electric Company has been incorated with a capital stock of $2,000 by J. A. Copen and others.

BATH, N. Y.—The Citizens' Electric Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $50,000, and the directors are E. J. G. Tower, W. H. Hallock and Thomas Shannon, all of Bath, N. Y.

MASSILLON, OHIO.—The Massillon Electric & Gas Company has been incorporated with a capital stock of $500,000 by J. W. McOlymonds, C. H. Russell and others.

MILFORD CENTER, OHIO.—The Union Light & Water Company has been incorporated with a capital stock of $12,000 by Edward A. Schambs, L. H. Osborne, M. H. Dea, Fred Richter and Frank Brugler.

CALUMET, OKLA.—The Bethany & Calumet Telephone Company has been incorporated with a capital stock of $1,000 by Martin Day, F. R. Siton and Hugh Bright, all of Calumet.

CHECOTAH, OKLA.—The Checotah & Shawnee Interurban Railway Company has been chartered to construct and operate an electric railway from Fort Smith, Ark., to Shawnee, Okla. The road when completed will be 160 miles in length and will cost $1,280,000. The incorporators are: R. B. Hutchinson, R. G. Smith, L. F. Cain, R. D. Martin and W. M. Duffy, all of Checotah. The capital stock of the company is placed at $500,000.

CYRIL, OKLA.—The Cyril Southwestern Telephone Company has filed articles of incorporation with a capital stock of $500. The incorporators are: A. A. Hiatt, J. W. Thompson, F. A. Childs, R. W. Browning and G. E. Thorp, all of Cyril.

JESSUP, PA.—The Jessup Electric Light Company has been incorporated by John J. Sweeney, H. V. Lawlor and John Smoulter, of Jessup. The company proposes to furnish electricity for lighting the borough.

WEST CHESTER, PA.—Governor Stuart has approved the charter of the West Chester & Wilmington Electric Railway Company, which proposes to build an electric railway nine miles long from West Chester along the West Chester and Wilmington Turnpike to the Delaware State line. A separate charter will be obtained for the portion of the line in Delaware. The company is capitalized at $54,000, and the directors are Thomas E. O'Connell, of West Chester, president; C. P. Faucett, of Westtown; James A. Kirkpatrick, of Birmingham; Charles Gleason, of Brandywine; F. Harvey Day, of Talleyville, and M. A. O'Connell, of West Chester.

TREZEVANT, TENN.—The Trezevant Telephone Company has been organized and the following officers elected: Oliver C. Sloan, president; William G. Quinn, vice-president; R. E. Ware, secretary; and M. F. Hurdle, treasurer.

KERRVILLE, TEX.—The Kerrville Telephone Company has been incorporated, with a capital stock of $30,000, by J. W. Taylor and others.

COON VALLEY, WIS.—The Coon Valley Farmers' Telephone Company has been incorporated with a capital stock of $4,600, by Louis O. Bryce, Thomas Johnson and C. F. Bunkman.

BOWMANSVILLE, ONT.—The Dereham Telephone Company has been incorporated with a capital stock of $30,000 by R. W. Hawkins, I. Harris, J. W. Hopkins, S. A. Freeman, H. Minshall and K. E. Freeman, of Dereham.

DEREHAM, ONT.—The Dereham Telephone Company has been incorporated. The company is capitalized at $20,000.

DRUMBO, ONT.—The Princeton & Drumbo Telephone Company has been incorporated, with a capital of $30,000.

BURNT RIVER, ONT.—The Burnt River Telephone Company, Ltd., has been incorporated with a capital stock of $5,000 by W. Fell, J. Hodgson, A. B. Townsend, R. Maconachie and W. Britnell, of Somerville.

LANSDOWN, ONT.—The Lansdown Rural Telephone Company has been incorporated with a capital stock of $20,000 by W. J. Webster, R. J. Mitchell, O. W. Landon, all of Lansdown, Ont.

MELBOURNE, ONT.—The Caradoc-Ekfrid Telephone Company, Ltd., has been incorporated with a capital stock of $10,000 by A. B. McDonald, N. A. Galbraith, J. A. McEwen, of Ekfrid, and F. L. Williams, of Caradoc.

PRINCETON, ONT.—The Princeton & Drumbo Telephone Company has been incorporated with a capital stock of $20,000 by F. J. Daniel, W. H. Wells, T. Conway and W. Courtney, of Princeton.

Legal.

PRICE OF GAS AND ELECTRICITY IN SARATOGA.—The Court of Appeals on Jan. 8 denied a motion made in behalf of the Attorney General to dismiss the appeal of the Saratoga Gas, Electric Light & Power Company from the judgment of the appellate division, which sustained the order of the old State Commission of Gas and Electricity, fixing the price of gas and electricity in the village of Saratoga. By its denial of the motion to dismiss, the Court of Appeals apparently takes the attitude that it will hear appeals arising from orders of commissions, such as that of gas and electricity. The court fixed for the argument the date of Jan. 20.

A FRANCHISE DECISION.—The Supreme Court of the United States has handed down a decision in the case of the city of Hutchinson, Kan., and the Hutchinson Water, Light & Gas Company, dismissing the company's demurrer to the pleadings. The company brought suit to secure an injunction to prevent the city of Hutchinson from granting a franchise to furnish electric light to the People's Electric Light & Power Company,

and against the latter company to prevent its operating under the franchise. In Judge Pollock's court, at Topeka, the city entered a demurrer to the grounds upon which the Water Company based its complaint, which was that the franchise granted it by the city was exclusive and had been paid for by a valuable consideration. Judge Pollock sustained the demurrer. The Water, Light & Gas Company appealed to the United States Supreme Court. About a month ago the case was heard. The decision denies the power of the city of Hutchinson to grant an exclusive franchise to any public service corporation, and while in the case the franchise specified was for furnishing light, it was stated by attorneys that it will cover gas, water or other divisions of a public service corporation.

Obituary.

HON. EDWARD P. PAGE, of Skowhegan, Me., a well-known bank official and a former member of both branches of the Maine Legislature, died suddenly Jan. 3, of heart failure. Mr. Page was president of the Skowhegan Electric Light Company, treasurer of the Skowhegan Pulp Company, and financially interested in many other local enterprises.

MR. W. H. FAIRBANK.—Mr. Wilson H. Fairbank, Massachusetts commissioner to the Portland Exposition and recently commissioner from that State to the Jamestown Exposition, died at Warren, Mass., on Jan. 7. Mr. Fairbank returned from Jamestown early in December, suffering from malarial fever. Heart disease following this malady caused his death. He was seventy-one years old. Between 1864 and 1891 Mr. Fairbank served as superintendent of construction for various telegraph companies, including the United States Telegraph Company, the Atlantic & Pacific, the Postal and the American Telephone & Telegraph Company, and he built thousands of miles of telegraph and telephone lines throughout the country.

MR. A. B. SCOTT.—After an illness of about a year, Alfred B. Scott, of the firm of Scott & Bowne, pioneer in the emulsion business, died recently at Geneva, Switzerland, from paralysis. He was 60 years old. A daughter married Mr. J. S. Anthony, well known in the executive branch of the General Electric Company. He was born in Poughkeepsie, N. Y., and many years ago entered the emulsion industry. About twelve years ago he went to Geneva, from which city he established branches in Europe, Asia and Africa. These branches are separate from the American business, and he was in full charge of them. Up to a year ago he had large financial interests in the electric railways of Buenos Ayres, and his wealth was considerable. Mr. Scott, in connection with Theodore N. Vail, of Boston, reorganized the La Capital tramway system of Buenos Ayres, which was recently sold to a Belgian syndicate when Mr. Vail became president of the American Bell Telephone Company and failing health compelled Mr. Scott to retire.

Personal.

MR. JAMES FORSYTHE, of Springfield, Mass., has been appointed manager of the municipal electric light plant at Chicopee, Mass., to succeed Mr. George E. Stebbins, the present manager.

MR. H. W. KENT, general superintendent of the British Columbia Telephone Company, has resigned. Mr. G. H. Halse, formerly secretary of the company, has been appointed to succeed Mr. Kent.

MR. F. A. SCHROEDER, for several years connected with the Boston Heat, Power & Lighting Company, which controls the Leominster, Clinton and Ayer lighting companies, has been appointed to succeed Mr. Fred Fullam as superintendent of the Leominster, Clinton and Ayer plants.

MR. W. R. GARTON, formerly president and treasurer of the W. R. Garton Company, of Chicago, has associated himself with the Lord Electric Company, and has been appointed general manager of its manufacturing department. His headquarters will be located at its general offices, 213 West Fortieth Street, New York City.

MR. W. S. HULSE, of New York City, has succeeded to the work here of the late Mr. Louis J. Magee, as the representative in America of the interests of the Allgemeine Elektricitaets Company, of which Mr. Magee was a director. Mr. Hulse has been long and favorably known in the field of mechanical and electrical engineering.

MR. R. F. SCHUCHARDT, engineer of construction of the Commonwealth-Edison Company, of Chicago, has been awarded the Chanute medal of the Western Society of Engineers for the best paper on an electrical subject presented before that society during the year 1906. The paper which won this medal was on the subject, "The Rotary Converter Substation," presented in December, 1906.

MR. NORMAN R. COLE.—The *Canada Gazette* contains, in its issue for Jan. 11, 1908, the announcement of the appointment of Mr. Norman Richards Cole as special electrical measuring instrument expert to the Electrical Standards Laboratory, Inland Revenue Department, Ottawa. Mr. Norman Cole has, we understand, made a very special study of electrical measuring instruments, and his connection with the Canadian Standards Bureau promises some interesting results in the near future. Mr. Cole has been connected with some of the best instrument firms in Great Britain.

MR. FRED N. FOWLER, who has been superintendent for a number of years of the United Electric Light Company, of Springfield, Mass., has retired from his position to devote his entire time to the construction of the new plant. Mr. Fowler will have the title of consulting engineer. Mr. Walter H. Damon, chief engineer, has been promoted to the position of superintendent of the generating department, and will have entire charge of intendent of the generating department, and will have entire charge of the work in the three stations of the company. Mr. W. H. Cross has been appointed chief engineer and will have charge of the steam machinery under the supervision of the superintendent of generating. Mr. Paul Selden, superintendent of the meter department, has been promoted to chief electrician, and Mr. J. F. Murray has been promoted to the position of superintendent of the meter department.

VIELE, BLACKWELL & BUCK is the name of the consulting engineering firm of 49 Wall Street, New York City, which will carry on the business of the firm of somewhat similar name to which it succeeds. Mr. H. L. Cooper has retired from the company and his place has been taken by Mr. H. W. Buck, an officer whose engineering rank and ability have already given him high place in this country.

Trade Publications.

POLYPHASE INDUCTION MOTORS, ranging in rating from 15 horse-power to 200 horse-power, are discussed briefly in bulletin No. 88 of the Crocker-Wheeler Company, Ampere, N. J.

"THE ENGINEERING DIGEST" is the new name of "Technical Literature," issued at 220 Broadway, New York, as a monthly compendium or abstract of articles, etc., in the technical press.

ENGINEERING WORK.—Westinghouse, Church, Kerr & Co. have issued No. 3 of the publication "Work Done." Complete descriptions are given of the power station in Long Island City, the energy transmission line and third-rail system, the sub-stations, and the car equipment of the Long Island Railroad.

MACHINE TOOLS.—Catalogue No. 45, recently issued by the Newton Machine Tool Works, Philadelphia, Pa., is a handsome 303-page publication giving excellent illustrations of machine tools of all types, and brief descriptions of each type illustrated. It is interesting to note that many of the large machines are equipped with direct-connected motors.

ELECTRICAL SPECIALTIES.—Catalogue No. 17, of Pass & Seymour, Solvay, N. Y., is an artistic pocket-size publication containing 144 pages devoted to porcelain and other specialties for electrical installations. Where porcelain, brass and hard rubber are shown together effective use is made of colored ink. Prices are quoted on all articles illustrated.

REFLECTOR LAMPS.—The Germania Electric Lamp Company has published a 32-page catalogue illustrating and describing the various types of the incandescent lamp of its manufacture. The latter portion of the pamphlet is devoted to reflector lamps, which are very effectively shown in colored illustrations, while each type is accompanied by a distribution diagram.

TRANSFORMERS.—The Wagner Electric Manufacturing Company, of St. Louis, Mo., has issued a transformer "flyer" which replaces a bulletin, the edition of which is now exhausted. It comes between the company's regular transformer bulletin and its power transformer bulletin. It contains, moreover, a good deal of data that will be interesting to our readers as regards the history of long distance transmission.

TELEPHONE HISTORY.—The Rocky Mountain Bell Telephone Company has just issued a large and interesting pamphlet, well illustrated, telling the story of its growth from 1883 to 1907. As is well known, the system operates in a very difficult section of the country, and some of the mountains and gorges are here depicted. There are now 134 public exchanges, and the revenue in 1906 was $1,410,900.

THE MASSACHUSETTS FAN COMPANY, Watertown, Mass., has just issued an additional section of its perpetual catalogue. This section, which comprises 16 pages, and is entitled "Vertical and Horizontal Engines for Fan Driving" includes illustrations, descriptions, dimensions and horse-power tables. The entire catalogue is thus brought up to a total of 116 pages of exceptionally valuable matter relating to blowers and exhausters, heating, ventilating, drying and mechanical draft apparatus, etc.

FEED-WATER HEATING.—How to obtain more hot water from a boiler feed-water heater, where the quantity of exhaust is limited, is discussed in a circular entitled, "May We Inquire?" which is being distributed by the Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa. It shows that open heaters have the advantage over closed heaters in this respect and that they further save the condensed exhaust. The increased temperature of the feed-water from an open heater, where the supply of exhaust steam is limited, is represented by the following expression:

$$H\frac{p^2}{1+p}$$

where H = the heat in a pound of exhaust steam above the initial temperature of the feed-water, and p = the percentage of exhaust, as compared with the total output of steam from the boilers. The argument is also made that the closed heater does not provide for the purification of the water, nor for the liberation of air and carbonic acid gas, as does an open heater; further, that the closed heater cannot serve as an independent oil separator, expansion and return tank, pump governor, hot well, etc., as can a Cochrane heater. It is further claimed that an open heater is much more easily cleaned than is a closed heater, this point being illustrated by some interesting photographs. This pamphlet is sent upon request.

THOMSON HORIZONTAL EDGEWISE INSTRUMENTS.—The use of instruments of the highest possible accuracy is essential to the economical and satisfactory operation of electrical properties. The General Electric Company, Schenectady, N. Y., manufactures a complete line of horizontal edgewise instruments for switchboard service, including ammeters, voltmeters, single-phase wattmeters, polyphase wattmeters, frequency indicators and power factor indicators. Bulletin No. 4551, recently issued by the company, illustrates and describes the various types, giving dimension sketches and a complete set of full-sized scales. The wattmeters, power factor indicators and frequency indicators are constructed on the direct-reading dynamotor principle; the ammeters and voltmeters on the well-known Thomson inclined coil principle. All the instruments are of uniform size, thus giving a pleasing appearance when installed. The horizontal, edgewise design has been adopted for the majority of high-grade work, since it was first introduced some years ago. While primarily designed for alternating current service, the voltmeters, ammeters and wattmeters can be used with good results on direct current.

Business Notes.

THE BELL ELECTRIC MOTOR COMPANY has moved its office from Prince Street and West Broadway to 120 Centre Street, New York.

THE MARINE ENGINE & MACHINE COMPANY has moved its New York office from 126 Liberty Street to 230 West Thirteenth Street. Its new telephone number is 4730 Chelsea.

WIRELESS CLUSTERS.—The Benjamin Electric Manufacturing Company, of Chicago, announces that it has authorized the Dale Company, of New York, to market wireless clusters, details of which are covered by patents owned by the Benjamin Company.

THE PEERLESS RUBBER MANUFACTURING COMPANY has recently opened its new retail department at 88 Chambers Street, New York, which connects with its present store at 16 Warren Street. Owing to its somewhat limited space it has hitherto not been able to carry a large stock, but with the additional store, it will always have on hand a full and complete line of mechanical rubber goods to fill immediate demands.

THE EXCELLO ARC LAMP COMPANY has established a branch office and distributing center at 118 West Jackson Boulevard, Chicago, in charge of Mr. G. W. Armstrong. Stock will be carried at this point for distribution to all surrounding territory, and the company will be prepared to make the Excello flaming arc lamp as prominent a factor in the lighting of industrial works in the West as it has been made in the East.

THE EXCELLO ARC LAMP COMPANY has opened a depot in the Electrical Building, No. 116-132 Jackson Boulevard, Chicago, for the convenience of the Western trade. Mr. George W. Armstrong, who has been the Western traveling representative of the company for the past two years, will be in charge of this branch, and will carry in stock at all times for rush orders a supply of lamps, carbons, globes and all other accessories and parts.

THE GENERAL ELECTRIC COMPANY'S exhibit at the third annual Trades Exposition at Chicago occupies a space of over 700 square feet in the center of the Coliseum. The exhibit is devoted principally to cooking and heating devices, among which are shown luminous radiators, coffee percolators, chafing dishes, water heaters, complete cooking and baking outfits and flat-irons. All of these articles are shown in actual use and visitors are served with electrically cooked delicacies, in an elaborately furnished dining-room. An interesting feature of the exhibit is the color booth, in which color values are compared under various artificial lights, including the enclosed arc, incandescent, Nernst and Welsbach. This is the first actual comparison of this nature that has been made at a Chicago show and should prove of interest to managers of clothing and drygoods stores. Of further interest will be mutoscope pictures of the Schenectady factory.

THE LORD ELECTRIC COMPANY, of New York, Boston and Chicago, has very recently made a marked change and improvement in its manufacturing department. It is greatly broadening the field of its activities and the scope of this department, having acquired some very valuable patent rights. It is preparing to manufacture the devices covered by these patents. The company has been actively engaged in the electrical field manufacturing and supplying rail bonds, lightning arresters, kindred devices and appliances. The thoroughness with which it has undertaken and prosecuted its work has been clearly demonstrated by the very broad field covered and the amount of trade developed. It has gained an enviable reputation and has assumed a position of importance. The success attained through its efforts has now encouraged it to take on additional valuable specialties, all of which are covered by strong patents and which, it is believed, will appeal to the operator because of their superior character and the fact that they effect a saving and thus materially increase dividends.

H. W. JOHNS-MANVILLE COMPANY.—One of the most interesting exhibits at the Chicago Electrical Show is that of the H. W. Johns-Manville Company, located in Space 15, Section E, opposite the main entrance. Last year the company exhibited for the first time its Victor combination meters, and this year it shows a complete line of both stationary and portable types. The added attraction this year is "Linolite," a new system of lighting. The company's booth is lighted by means of Linolite, which tends to show off the features of the Linolite system to excellent advantage. Linolite, which means "line-o-light," has been developed especially for window, stage and showcase lighting, as well as the illumination of desks, pictures and room interiors. It consists of an aluminum reflector 2¼ ins. wide and approximately 1 in. deep, in which fit tubular incandescent lamps 12 ins. between centers, each lamp having a filament extending its entire length. Another item of interest in this exhibit is asbestos wood, a fibrous substitute for wood, marble, slate and fibre, for fireproof construction and as an electrical insulation. This material has a wide range of uses, such as switchboards, panel boards, fireproof barriers, etc. It can be worked with ordinary wood-working tools the same as hard wood. A complete line of Noark fuses and fuse devices are also shown, as well as line material, electrotherms (electric heating pads), J-M friction tape, moulded mica, Monarch, Phoenix, Vulcabeston and Electrobestos insulations, asbestos pipe coverings, asbestos roofings, asbestos packings and asbestos household specialties. The company is represented by Messrs. H. M. Frantz, manager of the electrical department of the Chicago office; F. C. Frumweller and A. M. Chamberlin, of the Chicago office; A. M. Erskine, manager of the electrical department of the St. Louis office; H. M. Crosswell, manager of the electrical department of the Milwaukee office; G. A. Saylor, Milwaukee office, and W. F. Little, E. E., New York office.

Calendars.

THE AMERICAN CARBON & BATTERY COMPANY, East St. Louis, Ill., has issued a pleasing wall calendar for 1908. It shows a picture of a small boy with a loaf of bread in his hand and his dog looking up appealing for a share of the loaf. The picture is entitled, "We Demand a Division."

THE LAFAYETTE ELECTRICAL MANUFACTURING COMPANY has been particularly happy in the selection of a design for its wall calendar, both with respect to subject and treatment. A picture on a dark background represents a child rising in the morning, with a dog, in an attitude as if presenting a morning greeting.

THE GENERAL INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has been favoring its friends with a very attractive calendar. It is very original and quite out of the ordinary, the design having been made expressly for this purpose. A small supply was left after the regular list was covered, and as long as they last the General Incandescent Lamp Company will be glad to furnish copies of the calendar to any dealer, contractor, central station or isolated plant man on request.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 7, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

875,715. INTERCHANGEABLE ELECTRIC DISPLAY APPARATUS; Deronda Levy, New York, N. Y. App. filed April 5, 1905. Covers a keyboard apparatus for the illumination of electrical signs of that character in which any inscription can be produced by the illumination of different groups of lamps in each letter.

875,750. CARBON BRUSH FOR COMMUTATORS AND THE METHOD OF PREPARING SAME; E. C. Van Nort, Jr., St. Louis, Mo. App. filed March 19, 1906. The process of producing commutator brushes, which consists in treating ordinary block carbons with a boiling liquid having powdered plumbago suspended therein.

875,757. MAGNETIC CLUTCH; Thomas A. Watson, Milwaukee, Wis. App. filed April 1, 1907. A form of magnetic clutch having an expansion of the driven part produced by the torsion applied to a coil member.

875,784. APPARATUS FOR THE MANUFACTURE OF COPPER ELECTROTYPES; S. O. Cowper-Coles, London, Eng. App. filed March 5, 1906. A method for producing electrotypes or copper shells for printing and other purposes. Has a revoluble drum within a cylindrical casing.

875,788. PRESSURE DEVICE FOR ELECTRIC CURRENT COLLECTORS; C. De Kando, Budapest, Austria-Hungary. App. filed May 6, 1905. A means for maintaining the requisite pressure between the trolley and trolley wire under different running conditions. Has a penumatic apparatus acting in conjunction with tension springs.

875,791. CONTROLLER REGULATOR; J. P. Durkin, Philadelphia, Pa. App. filed Aug. 31, 1907. The controller handle carries a disc having circumferential grooves in which ride a steel ball, which is also constrained by grooves in the surrounding casing.

875,706. LAMP BASE; T. W. Frech, Jr., Cleveland, Ohio. App. filed March 27, 1907. A form of lamp base having a projecting skirt coated with a closely adherent fibrous insulating material.

875,801. CONSTRUCTION OF INDUCTION ELECTRIC FURNACES; C. Gin, Paris, France. App. filed May 3, 1906. A form of induction furnace designed to obtain a uniform distribution of heat and uniform reactions in the different parts of the furnace.

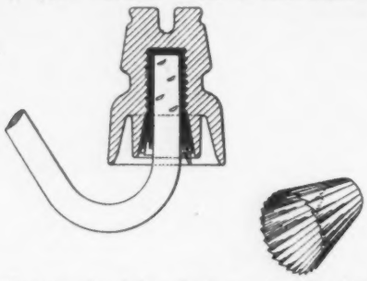
875,810. AUTOMATIC FIRE ALARM; B. C. and F. W. Hall, Elmwood, Ill. App. filed Jan. 12, 1907. Relates to improvements in auto-

matic fire alarm apparatus in which fusible elements are used to close an electric circuit, whereby suitable alarm devices are operated.

875,822. PRESSURE DEVICE FOR ELECTRIC CURRENT COLLECTORS; C. De Kando, Budapest, Austria-Hungary. App. filed Nov. 27, 1903. The trolley pole is impelled upward by a tension spring which can be released by a pneumatic cylinder fixed to the roof of the car. Has means for increasing the pressure when the car is operating at high speed.

875,830. SOCKET KEY CLAMP; M. Loewenthal, Newark, N. J. App. filed June 6, 1906. A means for sealing the button of an incandescent lamp in either on or off position. Includes a metallic band which clamps around the socket and embraces the turn button.

875,833. ELECTRIC ARC LAMP; J. A. Meaher, Cleveland Ohio. App. filed Oct. 29, 1906. Relates to details of construction of an enclosed



875,902.—Means for Insulating the Supports of Electric Conduits.

arc lamp having a reflector. The regulating mechanism is designed to maintain the arc by a solenoid and a ball clutch.

875,843. APPARATUS FOR TRACK CIRCUIT CONTROL; J. A. Peabody, Evanston, Ill. App. filed July 25, 1907. A means for supplying alternating current to track rails for signaling purposes comprising a battery having its circuit connected to a pole changer and another battery having its circuit connected to a vibrator operating said pole changer.

875,872. WIRE-CONNECTOR; John J. Walsh, Yonkers, N. Y. App. filed April 10, 1905. Has a split bolt with a plurality of washers between which the wires are passed. In place of a nut, patentee makes use of a set screw which clamps the endmost washer.

875,900. REVERSING SWITCH; A. C. Eastwood, Cleveland, Ohio. App. filed April 19, 1906. A form of reversing switch having a pair of magnets operating solenoids to produce continuous rotation of a commutator which is engaged by spring-impelled brushes.

875,901. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; A. C. Eastwood, Cleveland, Ohio. App. filed May 22, 1906. A diagram of circuits for a train-control system having a plurality of electric motors controlled by a single pilot circuit, through contactors.

875,902. MEANS FOR INSULATING THE SUPPORTS OF ELECTRIC CONDUITS; C. E. Enger, Stockholm, Sweden. App. filed Nov. 15, 1906. An interponent for insulators comprising a plurality of separately imposed caps, the sides of which have a series of folds to impart to the caps a relative amount of fulness.

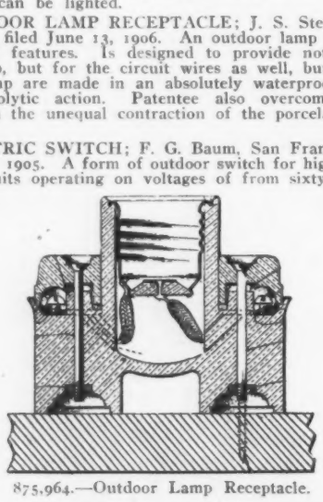
875,910. ELECTRIC CHAIN WELDING MACHINE; H. Helberger, Munich, Germany. App. filed Feb. 15, 1904. A complete apparatus for electrically welding together the links of a chain.

875,911. SAFETY SIGNAL SYSTEM FOR RAILWAYS; W. F. Herting, et al., Baltimore, Md. App. filed April 20, 1907. Railroad signal system including electrical and mechanical features. Has mechanically operated signals and electrical circuits completed by the movement thereof.

875,942. ACETYLENE LAMP AND LIGHTING DEVICE FOR AUTOMOBILES AND OTHER VEHICLES; S. M. Meyer, New York, N. Y. App. filed Dec. 21, 1905. A device including a form of controller and a pair of dry batteries designed to be located on the dash of an automobile and including circuits to the various lamps by which they can be lighted.

875,964. OUTDOOR LAMP RECEPTACLE; J. S. Stewart, New York, N. Y. App. filed June 13, 1906. An outdoor lamp receptacle having a variety of features. Is designed to provide not only a support for the lamp, but for the circuit wires as well, but the connections with the lamp are made in an absolutely waterproof way, so as to avoid electrolytic action. Patentee also overcomes the breaking strains, from the unequal contraction of the porcelain and metal in the winter.

875,978. ELECTRIC SWITCH; F. G. Baum, San Francisco, Cal. App. filed Oct. 24, 1905. A form of outdoor switch for high potential transmission circuits operating on voltages of from sixty to one hundred



875,964.—Outdoor Lamp Receptacle.

thousand volts. Patentee has horizontally swinging arms carried by petticoated insulators and engaging metallic clips which are fastened to other petticoated insulators. Three such circuit-breaking arms are provided for a three-phase system all simultaneously operated by a single lever.

875,981. MOTOR CONTROLLING MECHANISM; H. W. Cheney, Norwood, Ohio. App. filed June 8, 1906. Provides means whereby the starting resistance of an alternating current motor may be arranged outside of the rotor, but the final short-circuit may take place within the rotor.

875,982. MOTOR CONTROLLING MECHANISM; H. W. Cheney, Norwood, Ohio. App. filed March 30, 1907. Provides various features of a controller for induction motors by which the operating current for the short-circuiting device may flow until its work is done, however rapidly the operator moves the controller, while said current is stopped as soon as its work is done.

876,039. HAND MIRROR; H. Burrell, Sheffield, England. App. filed July 8, 1907. A mirror for opticians having an electric lamp on the surface which illuminates the object to be reflected. The mirror is rotatable on its support and has a clear space at one point and an electric lamp carried by the mirror and arranged at the back of said clear space.

876,055. SWITCH; C. H. Holley, Visalia, Cal. App. filed June 16, 1905. An oil bath switch of the type having a downwardly projecting plunger carrying depending switch elements at its upper end which dip into oil baths within the switch casing. Designed for use on outdoor overhead systems.

876,059. SPLIT KNOB; W. H. Irons, Beaver, Pa. App. filed Oct. 11, 1906. Two cylindrical blocks with registering channels between which the circuit wire is received. The blocks clamp upon said circuit wire by a central supporting screw or pin.

876,069. TELEGRAPH TRANSMITTER; Charles E. Lee, Chicago, Ill., and Lewis K. Miller, Brooklyn, N. Y. App. filed May 14, 1906. A typewriter telegraph having operating keys and a cam impelled lever which vibrates between platinum points in a manner analogous to the ordinary telegraph key.

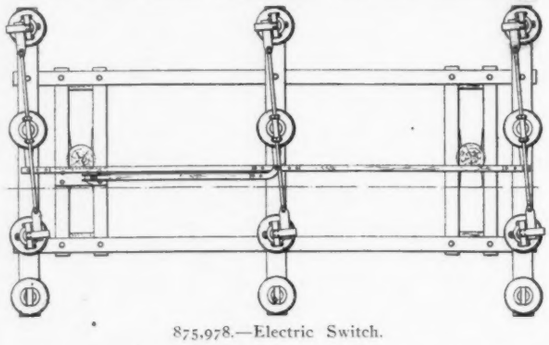
876,160. CLAMP; Winn D. Faris, Medicine Lodge, Kan. App. filed Nov. 20, 1907. A form of strain insulator including a pair of iron straps which embrace the cross arm of a telegraph pole and have pivoted between them a cylindrical insulator.

876,165. WIRELESS TELEGRAPH TRANSMITTING SYSTEM; Lee DeForest, New York, N. Y. App. filed May 11, 1904. The combination with a transmitting loop antenna constituting a closed oscillating circuit, of a closed oscillating energizing circuit associated therewith and attuned thereto.

876,169. RECEPTACLE FOR INCANDESCENT LAMPS; Gilbert W. Goodridge, Bridgeport, Conn. App. filed June 14, 1907. A sign receptacle having laterally projecting lugs in front and back with connecting strengthening ribs.

876,187. JUNCTION BOX; Harry H. Hornsby, New York, N. Y. App. filed May 12, 1906. A sheet metal box having a U-shaped body with end plates and adjustable ears or lugs for attachment to any supporting surface.

876,192. SIGNAL ALARM SYSTEM; Oliver B. Kaiser, Norwood, Ohio. App. filed April 30, 1906. Provides means whereby an apparatus is operated automatically to transmit a signal from a transmitting point to a central office, in which after the apparatus has been set in motion it is positively operated by power and continues in such



875,978.—Electric Switch.

positive operation for a limited time before the transmitting wheel is positively brought into operation.

876,207. PUSH BUTTON ELECTRIC SWITCH; William G. Mann, Bridgeport, Conn. App. filed June 20, 1907. A push button switch having contacts for connection with more than one circuit. Has a plurality of push buttons operating separate switch blades and a single release button adapted to unlatch all of said blades whereby they are returned to normal position.

876,233. ELECTRIC LAMP RECEPTACLE; Herbert E. Plass, Newark, N. J. App. filed Aug. 1, 1907. A form of lamp receptacle adapted to Christmas tree decoration. Has a cup part containing lamp terminals with rearwardly projecting prongs, and a screw and a co-operating cap and nut threaded on to the screw and adapted to be turned by hand to hold the cap in place.

876,241. UNDERGROUND SYSTEM OF LAYING ELECTRICAL CONDUCTORS; Wilhelm Schreiber, Munich, Germany. App. filed March 28, 1907. Relates to the arrangement of the conduits of cables and the construction of the junction boxes and wear distributing devices for connecting the conductors in an underground system, and more especially to a district telephone system.

876,253. ELECTRIC SAD IRON; William J. Barr, Cleveland, Ohio. App. filed May 27, 1907. The flatiron is made hollow with a removable insulating cover and contains a removable resistance element within a separate casing.

876,273. FUSE DEVICE; Frank B. Hall, Wheeling, W. Va. App. filed Dec. 30, 1905. A construction of fuse built of flat mica plates between which the fusible element is passed. The fusible element threads through a central perforated mica plate at the middle portion of its length.

876,274. ELECTRICALLY CONTROLLED RELEASING DEVICE; Charles J. Kintner, New York, N. Y. App. filed April 20, 1906. An electrically controlled releasing device for use in connection with railway signals and provides a solenoid having a core operatively connected with a valve stem or other appliance which it is desired to release, and adapted to impart a blow to the part to be released.

876,281. COMBINATION SENDING AND RECEIVING WIRELESS TELEGRAPH APPARATUS; Albert L. New, Los Angeles, and William N. Hickman, Avalon, Cal. App. filed Sept. 17, 1906. Relates to a complete wireless telegraph system designed to prevent interference by atmospheric electricity, and to provide a double set of aerial capacities, one of which is adapted for sending and the other for receiving.

876,312. QUADRUPLEX OR MULTIPLEX TELEGRAPHY; Lawrence Connell, Jr., Portland, Ore. App. filed March 29, 1907. Provides for overcoming the false signals in a neutral relay of a quadruplex telegraph system. Makes use of steadying magnets for holding the armature steady against vibration during the moments of no magnetism.